

## **Supplementary material**

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## **References**

## **Section S1: Electronic search strategy, coding-scheme for the systematic review and data analysis**

An initial search strategy was developed in Medline/Ovid by a medical information specialist and tested against a list of core references to see if they were included in the search result. After refinement and consultation, complex search strategies were set up for each information source based on database-specific controlled vocabulary (thesaurus terms / subject headings) and textwords. Synonyms, acronyms, and similar terms were included in the textword search. The medical bibliographic databases MEDLINE, Embase and the Cochrane Library, Web of Science and CINAHL as well as the clinical trial registries ICTRP and clinicaltrials.gov were searched. All searches were run on 30th of January 2023.

Limits have been applied to publication of English, French, German, Greek or Italian language. No further limits have been applied in any database considering study types, languages, or any other formal criteria.

The following search concepts were applied according to the PICO framework: 1. "semicircular canal dehiscence" as the population/problem, 2. "transmastoid plugging" as the intervention, 3. no comparison was applied, 4. no outcome was applied. Synonyms, acronyms, and similar terms were used for all concepts in the textword search, as well as the respective thesaurus terms.

### **Ovid MEDLINE(R) ALL <1946 to January 30, 2023>**

Search Date: 31/01/2023

- 1 exp Semicircular Canal Dehiscence/ 75
- 2 (((Semicircular or semi-circular) adj4 canal\* adj4 dehiscence\*) or (canal\* adj4 dehiscence\* adj4 syndrome\*) or tullio phenomen\* or sscd or scds).mp. 1368
- 3 1 or 2 1368
- 4 exp Semicircular Canals/su 466
- 5 ((transmastoid\* or tm) and (management or approach\* or repair\* or plug\* or surfac\* or resurf\* or cap\* or surg\* or technique? or occlus\* or occlud\* or blog\* or clog\*)).mp. 34856
- 6 4 or 5 35256
- 7 3 and 6191
- 8 limit 7 to (english or french or german or greek or italian) 185

### **Embase.com (1947 to 30 January 2023)**

Search Date: 31/01/2023

#9. #7 AND #8 282  
 #8. [english]/lim OR [french]/lim OR [german]/lim OR 38,834,416  
 [greek]/lim OR [italian]/lim  
 #7. #3 AND #6 286  
 #6. #4 OR #5 25,241  
 #5. (transmastoid\*:ti,ab,kw,de OR tm:ti,ab,kw,de) AND 24,033  
 (management:ti,ab,kw,de OR approach\*:ti,ab,kw,de OR repair\*:ti,ab,kw,de OR  
 plug\*:ti,ab,kw,de OR surfac\*:ti,ab,kw,de OR resurf\*:ti,ab,kw,de OR cap\*:ti,ab,kw,de OR  
 surg\*:ti,ab,kw,de OR technique\*:ti,ab,kw,de OR occlus\*:ti,ab,kw,de OR occlud\*:ti,ab,kw,de  
 OR blog\*:ti,ab,kw,de OR clog\*:ti,ab,kw,de)  
 #4. 'semicircular canal'/exp AND 'surgery'/exp 1,321  
 #3. #1 OR #2 2,135  
 #2. (((semicircular OR 'semi-circular') NEAR/4 canal\* 2,135  
 NEAR/4 dehiscence\*):ab,kw,ti,de) OR ((canal\* NEAR/4 dehiscence\* NEAR/4  
 syndrome\*):ab,kw,ti,de) OR 'tullio phenomen\*':ab,kw,ti,de OR sscd:ab,kw,ti,de OR  
 scds:ab,kw,ti,de  
 #1. 'semicircular canal dehiscence'/exp 173

#### Cochrane Library <1996 to present>

Search Date: 31/01/2023

#1 [mh "Semicircular Canal Dehiscence"] 1  
 #2 ((Semicircular:ti,ab,kw OR semi-circular:ti,ab,kw) NEAR/4 (canal\*:ti,ab,kw NEAR/4  
 dehiscence\*:ti,ab,kw)) OR (canal\*:ti,ab,kw NEAR/4 dehiscence\*:ti,ab,kw NEAR/4  
 syndrome\*:ti,ab,kw) OR ("tullio" NEXT phenomen\*):ti,ab,kw OR sscd:ti,ab,kw OR  
 scds:ti,ab,kw 45  
 #3 #1 OR #2 45  
 #4 [mh "Semicircular Canals"/su] 4  
 #5 (transmastoid\* OR tm):ti,ab,kw AND (management OR approach\* OR repair\* OR  
 plug\* OR surfac\* OR resurf\* OR cap\* OR surg\* OR technique\*):ti,ab,kw 2778  
 #6 #4 OR #5 2782  
 #7 #3 AND #6 0

#### Web of Science Core Collection (Clarivate Analytics) (1900-2023)

(Science Citation Index Expanded: WOS.SCI: 1900 to 2023, WOS.AHCI: 1975 to 2023,  
 WOS.ESCI: 2018 to 2023, WOS.ISTP: 1990 to 2023, WOS.SSCI: 1900 to 2023, WOS.ISSHP:  
 1990 to 2023)

Search Date: 31/01/2023

1	TS=((transmastoid* OR tm) AND (management OR approach* OR repair* OR plug* OR surfac* OR resurf* OR cap* OR surg* OR technique\$ OR occlus* OR occlud* OR blog* OR clog*))	81961
2	TS=((Semicircular OR semi-circular) NEAR/4 canal* NEAR/4 dehiscence*)	666
3	TS=(canal* NEAR/4 dehiscence* NEAR/4 syndrome*)	272

4	TS=("tullio phenomen*" OR sscd OR scds)	1332
5	#2 OR #3 OR #4	1797
6	#1 AND #5	80

# CINAHL (via EBSCO) (1982 to 30 January 2023)

Search Date: 31/01/2023

S8	S3 AND S6	93	Narrow by Language: - english Search modes - Find all my search terms
S7	S3 AND S6	93	Search modes - Find all my search terms
S6	S4 OR S5	1,820	Search modes - Find all my search terms
S5	TI ( ((transmastoid* OR tm) AND (management OR approach* OR repair* OR plug* OR surfac* OR resurf* OR cap* OR surg* OR technique# OR occlus* OR occlud* OR blog* OR clog*)) ) OR AB ( ((transmastoid* OR tm) AND (management OR approach* OR repair* OR plug* OR surfac* OR resurf* OR cap* OR surg* OR technique# OR occlus* OR occlud* OR blog* OR clog*)) )	1,706	Search modes - Find all my search terms
S4	(MH "Semicircular Canals/SU")	141	Search modes - Find all my search terms
S3	S1 OR S2	4,524	Search modes - Find all my search terms
S2	TI ( (((Semicircular OR semi-circular) N4 canal* N4 dehiscence*) OR (canal* N4 dehiscence* N4 syndrome*) OR "tullio phenomen*" OR sscd OR scds) ) OR AB ( (((Semicircular OR semi-circular) N4 canal* N4 dehiscence*) OR (canal* N4 dehiscence* N4 syndrome*) OR "tullio phenomen*" OR sscd OR scds) )	4,509	Search modes - Find all my search terms
S1	(MH "Semicircular Canal Dehiscence") OR (MH "Superior Semicircular Canal Dehiscence Syndrome")	77	Search modes - Find all my search terms

**The World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP)** Search Date: 31/01/2023

Advanced Searches:

- |               |                   |                         |
|---------------|-------------------|-------------------------|
| 1. Title:     | canal dehiscence* | Recruitment status: ALL |
| 2. Condition: | canal dehiscence* | Recruitment status: ALL |
| 3. 1. OR 2.   | 1                 |                         |

**Clinicaltrials.gov**

Search Date: 31/01/2023

- |                          |                   |   |
|--------------------------|-------------------|---|
| 1. Condition or disease: | canal dehiscence* | 1 |
|--------------------------|-------------------|---|

Recruitment status: All studies

Recruitment: All studies

Study results: All studies

Study type: All studies

## **Inclusion and exclusion rules for abstracts & full-text manuscripts**

Our search identified 643 unique citations and we sought to examine 358 full abstracts, of which 270 were excluded at the abstract level (see PRISMA flow chart). After initial screening, there were a total of 23 disagreements about study inclusion for the two reviewers (ME and RP, kappa= 0.814). These differences were resolved by discussion and adjudication by a third reviewer. Overall disagreement on reason for exclusion was 18%. We demanded concordance on reason for full-text exclusion and resolved differences by discussion.

Among the excluded abstracts, the distribution was as follows: 1 excluded due to language, 70 excluded due to type of study, 4 were animal research, 143 were not about transmastoid approach of superior semicircular canal; 19 were not about plugging the superior semicircular canal; 33 did not include audiometry results.

We sought to examine 88 full manuscripts. After initial screening, there were a total of 5 disagreements about study inclusion for the two reviewers (ME and RP, kappa=0.885). These differences were resolved by discussion and adjudication by a third reviewer. Overall disagreement on reason for exclusion was 1.4%. We demanded concordance on reason for full-text exclusion and resolved differences by discussion.

At the end of our full-text review, 72 were excluded and 16 were considered eligible (see PRISMA flow chart Figure 1). These eligible studies represented 2.3% of the total (n=643). Among all full-text manuscripts excluded, the distribution of reason for exclusion was as follows: 18 excluded due to type of study, 23 were not about transmastoid approach of superior semicircular canal; 2 were not about plugging the superior semicircular canal; 29 did not include pre-and postoperative pure-tone audiometry thresholds.

For 24 studies we attempted to contact the first or corresponding author for additional study information. 6 authors responded and 2 provided additional information.

### **Abstract review coding rules**

- 1) Coding status options are "Yes", "No", "Maybe". We will review full text of "Yes" and "Maybe".
- 2) Err on the side of "Maybe" if there is doubt about a "No"; this is more conservative.
- 3) If there is only a title, exclude it only if you feel confident; otherwise, code it as "Maybe".
- 4) Each "No" should be coded with a reason for exclusion.
- 5) Reasons for exclusion are listed below 0-5. Go through them in order from 0 to 5 for each abstract, coding the first reason for exclusion only, not multiple reasons for exclusion.
- 6) Two independent raters (ME/RP) will code reason for exclusion, and we will mandate agreement on exclusion reason at the abstract level.
- 7) Coding differences will be adjudicated, or consensus will be developed through dialogue.

1	Language	Other Language than English, Greek, Italian, French or German
2	Type of study	Study other than retrospective and prospective cohort studies or case reports
3	Animal research	Animal-surgery
4	No transmastoid	No reasonable prospect that the study includes transmastoid surgical access of the superior semicircular canal
5	No plugging	No reasonable prospect that the study includes semicircular plugging
6	No audiometry	No reasonable prospect that the study includes pre-and postoperative pure-tone audiometry thresholds

**Table S1-1: Abstract reasons for exclusion.**

#### **Full-text review coding rules**

- 1) Coding status options are “Yes” or “No”.
- 2) Each "No" should be coded with a reason for exclusion.
- 3) Reasons for exclusion are listed below 0-5. Go through them in order from 0 to 5 for each full manuscript, coding the first reason for exclusion only, not multiple reasons for exclusion.
- 4) Two independent raters (ME/RP) will code reason for exclusion, and we will mandate agreement on exclusion reason at the manuscript level.
- 5) Coding differences will be adjudicated, or consensus will be developed through dialogue.

1	Language	Other Language than English, Greek, Italian, French or German
2	Type of study	Study other than retrospective and prospective cohort studies or case reports
3	Animal research	Animal-surgery
4	No transmastoid	No transmastoid surgical access of the superior semicircular canal
5	No plugging	No semicircular plugging performed
6	No audiometry	The study doesn't include pre-and postoperative pure-tone audiometry thresholds
7	No functional preoperative hearing	No functional preoperative hearing

**Table S1-2: Full-text reasons for exclusion.**

## Section S2: QUADAS-2 assessment of included studies

For included studies, two independent raters (ME/PR) assessed the risk of bias or applicability concerns using QUADAS-2 tailored study criteria, resolving disagreements by discussion. The study of Morrison et al [16] was included in the meta-analysis, despite being a case report, as it was combined with a case series that included two additional patients from our clinic.

The QUADAS-2 tool for quality rating of diagnostic accuracy studies consists of four core domains (patient selection, index test, reference standard, and flow and timing). Reference standard was not applicable for our study. Risk of bias is assessed for all three domains (patient selection, index test and flow and timing), and applicability is assessed for the first two domains. Thus, five items per study are assessed to rate quality of evidence.

Two studies were rated as having high risk of bias/applicability concerns in the domain of “flow and timing”, as the postoperative audiogram was performed more than 18 months after surgery (see Table S2-1). However, both trials were included in the meta-analysis.

Author, Year	Sample Size	Patients' selection		Index Test		Flow and Timing
		Risk of bias	Applicability	Risk of bias	Applicability	Risk of bias
<i>Ellsperman S.E. et al, 2021 [19]</i>	26	low risk*	low risk	low risk	low risk	high risk
<i>Kawamura Y. et al, 2022 [15]</i>	7	low risk	low risk	low risk	low risk	low risk
<i>Gersdorff G. et al, 2022 [20]</i>	30	low risk	low risk	low risk	low risk	high risk
<i>Lin K.F et al, 2021 [21]</i>	29	low risk	low risk	low risk	low risk	low risk
<i>Nieto P. Et al, 2021 [22]</i>	9	low risk	low risk	low risk	low risk	low risk
<i>Stultiens J.J.A et al, 2022 [23]</i>	4	low risk	low risk	low risk	low risk	low risk
<i>Somers T. Et al, 2014 [24]</i>	11	low risk	low risk	low risk	low risk	low risk
<i>Van Haesendonck G. et al, 2016 [25]</i>	13	low risk	low risk	low risk	low risk	low risk
<i>Deschenes G.R. et al, 2009 [26]</i>	3	low risk	low risk	low risk	low risk	low risk
<i>Morrison M. et al, 2022+2 Insel cases [27]</i>	3	low risk	low risk	low risk	low risk	low risk
<i>Shaul C. et al, 2023 [28]</i>	24	low risk	low risk	low risk	low risk	low risk

Table S2-1: QUADAS-2 quality ratings for included studies (n=11) .

\*2 Patients were excluded from the study of Ellsperman et al because there was no available postoperative audiogram. The study was rated, though, as low risk as this type of exclusion has no systematic impact on the results of the study that deviate from the truth.



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