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ORIGINAL RESEARCH

Outcomes of Radiologist Recommendations for Temporal Bone CT to Assess Superior Semicircular Canal Dehiscence on Temporal Bone MRI

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ABSTRACT

BACKGROUND AND PURPOSE: Superior semicircular canal dehiscence can be detected on temporal bone MR images. Radiologists often recommend confirmation with temporal bone CT due to reported lower MRI positive predictive value. The value of these recommendations is unclear given that CT overestimates dehiscence due to volume averaging and that only a small proportion of patients with dehiscence on CT suffer from dehiscence syndrome. We thus evaluated final diagnoses and outcomes in patients who adhered to the recommended additional CT.

MATERIALS AND METHODS: This retrospective cohort observational study, performed at a multi-institution healthcare system, included consecutive temporal bone MRI reports 6/1/2021-5/31/2022 with a recommendation for additional temporal bone CT. We recorded: whether CT was performed, dehiscence present on CT, symptoms, final diagnosis, treatment decisions, and outcomes. Actionability elements (complete containing imaging modality, time frame, and rationale; unambiguous; unconditional; without multiplicity; and without alternate language) of the recommendations were extracted from a prior data set. Descriptive statistics were performed. A binomial generalized linear model was used to test the correlation of ambiguous recommendation language with recommendation adherence.

RESULTS: Summarize actual data. 5109 temporal bone MRI examinations were performed and interpreted by 34 radiologists. 187/5109 reports (3.7%) included a recommendation for additional temporal bone CT including 101/5109 (2.0%) specifically for suspected superior semicircular canal dehiscence. While 22% (22/101) of these recommended examinations were performed, only 32% of these (7/22) confirmed dehiscence. Ultimately, only 1 patient was diagnosed with dehiscence syndrome and was managed conservatively. No recommendations for additional imaging (0/101) met actionable criteria and 76.2% (77/101) were ambiguous. Ambiguous recommendations had 0.54 lower, but not statistically significant, odds of being performed (95% CI: 0.19-1.6, p=0.25).

CONCLUSIONS: Radiologist recommendations for temporal bone CT in the setting of questionable superior semicircular canal dehiscence findings on MRI appear to have negligible clinical value and thus it is likely most appropriate to report possible SSCD in the MRI report impression without recommending further imaging.

ABBREVIATIONS: SSCD = superior semicircular canal dehiscence.

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SUMMARY SECTION

PREVIOUS LITERATURE: The manifestations of SSCD syndrome are diverse and non-specific and SSCD is typically not considered a primary etiology for pulsatile tinnitus, aural fullness, and other non-specific presentations. Hence, an incidentally questionable SSCD on MRI has a low likelihood of being a significant contributor to the symptoms, even if confirmed by temporal bone CT, particularly given that diagnosing SSCD syndrome requires physiologic studies including cervical or ocular vestibular evoked myogenic potentials even when CT is positive. Even when SSCD syndrome is confirmed, symptoms typically do not progress and most patients find their symptoms not severe enough to warrant surgery.

KEY FINDINGS: Out of 101 radiologist-recommended additional temporal bone CT examinations to confirm SSCD, only 22 were performed, and only 1 of the 101 patients was determined to have SSCD syndrome, which was managed conservatively.

KNOWLEDGE ADVANCEMENT: Radiologist recommendations for temporal bone CT in the setting of questionable superior semicircular canal dehiscence findings on MRI appear to have negligible clinical value.

INTRODUCTION

Superior semicircular canal dehiscence (SSCD) is an inner ear abnormality with a defect in the bony covering of the superior semicircular canal. Some patients with SSCD experience SSCD syndrome, also called Minor's syndrome, typically characterized by sound or pressure-induced vertigo and sound-conducting hyperacusis.[1] Other symptoms in this condition are non-specific, and may include vestibular and visual disturbances along with auditory dysfunction. These symptoms include chronic disequilibrium, nystagmus, autophony, hearing loss, and pulsatile tinnitus.[2] Factors such as head trauma, barotrauma, and age, along with other potential pathophysiological mechanisms, may contribute to symptom onset in some cases[3]. SSCD has a prevalence of 0.5% in histologic surveys,[4,5] but has been reported at a rate of between 3% and 10% in CT examinations of the temporal bone.[5–9] It seems that CT has traditionally overestimated the extent of dehiscence and falsely suggests bone defects[6,10] due to volume averaging and the inability to visualize very thin bone layers, although modern CT techniques may mitigate that overestimation.[11]

SSCD can also be detected on temporal bone MR images.[12] Optimized fluid-sensitive steady state or T2-weighted 3D sequences with 0.7-0.8 mm spatial resolution have become relatively standard to evaluate inner ear structures,[13] and many centers now routinely perform these sequences with 0.5 mm spatial resolution. SSCD is defined on these images as the loss of the normal low signal layer (bone) between high signal labyrinth fluid and high signal CSF.[12,14,15] One study has shown that volume-rendered 3D MR images (T2-weighted turbo spin echo) allow for better perception of the defects in the superior semicircular canal, and facilitate understanding of the extent and location of the defects.[16] If SSCD is suspected on MRI, radiologists often recommend confirmation with temporal bone CT due to a reported lower positive predictive value of MRI.[12] However, the value of these recommendations is unclear given that CT overestimates dehiscence due to volume averaging and that only a small proportion of patients with dehiscence on CT suffer from dehiscence syndrome.

The primary aim of this study was to evaluate symptoms, rate of confirmed dehiscence on CT, final medical diagnosis, and treatment of those who adhered to the recommendation for CT for questioned SSCD. Secondarily we explored the association of recommendation actionability and ambiguity with recommendation adherence.

MATERIALS AND METHODS

Study Design and Setting

This retrospective cohort study was carried out at a multi-institution healthcare system that includes both academic and community radiologists across multiple institutions and practice settings with 4 separate physicians' groups. The MRI and CT protocols are heterogeneous due to different institutional preferences, and due to a wide range of scanner ages and capabilities with approximately 50 MRI scanners and 25 CT scanners. In general, all temporal bone MRI examinations performed in our healthcare system include a 3D cisternographic sequence acquired with an isotropic voxel size of 8 mm or smaller; examples include 3D T2 SPACE (Siemens), 3D CISS (Siemens), 3D T2 DRIVE (Phillips), and 3D FIESTA-C (GE). Similarly, temporal bone CT examinations are generally acquired and reconstructed with a slice thickness of 0.625 mm or smaller with generation of multiplanar reformats in the plane of the lateral semicircular canal[17] and a perpendicular coronal plane; Stenver and Poschl reformats are not routinely provided and can be reconstructed in the DICOM viewer. Some CT examinations are performed on cone beam CT systems and some are performed on photon counting CT systems, both of which provide higher resolution. Approval from our healthcare system's institutional review board was obtained, including a waiver of informed consent. The study was conducted in compliance with the requirements of the Health Insurance Portability and Accountability Act and is reported in line with Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Study Cohort

As previously published, radiologist recommendations for additional imaging in head and neck MRI and CT examination reports were identified using a validated deep learning algorithm[18–20] with level 4 technical efficacy evidence[21] and manual review was performed to identify and remove false positives from an available multi-institution healthcare system cohort of over 60,000 examinations in patients of all ages performed from 6/1/2021 to 5/31/2022.[18–20,22] For this study, we extracted consecutive temporal bone MRI reports in which a recommendation for additional temporal bone CT was included in the impression. These impressions were then reviewed by a neuroradiology fellow (PR) to determine if they were specifically recommendations to evaluate for SSCD.

Primary Outcomes Data Collection

For this study, a neuroradiology fellow (PR), supervised by a head and neck subspecialized board-certified neuroradiologist with 5 years of post-training experience (JPG), performed a chart review and recorded whether the recommended temporal bone CT was performed. In cases where the recommended temporal bone CT examinations were performed, the fellow recorded: whether the CT report confirmed, disproved, or did not comment on the reason for the recommendation in the MRI report; any patient presenting symptoms that can be associated with SSCD syndrome; treatment decisions associated with the CT examination; and associated medical outcomes as of 5/31/2024. These outcomes were updated by the supervising neuroradiologist as of 12/6/2024.

All temporal bone CT examinations were then reviewed by two board-certified neuroradiologists with 5-years (JPG) and 2-years post-training experience (JK) who scored whether SSCD was present. Inter-expert agreement was calculated as percentage agreement and assessed with Cohen's kappa. The two neuroradiologists then established consensus on the cases with disagreement, and the consensus scores were used to assess agreement with the reported presence of SSCD.

A medical school graduate research assistant (AAS), supervised by the same head and neck subspecialized board-certified neuroradiologist, performed a chart review of the subjects for which the recommended temporal bone CT examinations were not performed, and scored whether the ordering provider disagreed with the recommendation or the patient declined, the recommendation was unacknowledged in subsequent clinical care notes, or the patient never had clinical care follow-up in our healthcare system. The research assistant also summarized the information in the medical record.

Secondary Outcomes Data Collection

Using a previously defined and validated taxonomy,[22] the MRI report recommendations were assessed based on their actionable elements and categorized accordingly. Previous research has shown that using actionable elements in recommendations for additional imaging increases the likelihood of recommendation adherence.[22,23] As scored and previously published for this cohort,[24] actionable recommendations were categorized as complete (containing imaging modality, time frame, and rationale), unambiguous (no equivocal or vague language), unconditional (no qualifying language), without multiplicity (single option), and without alternate language (no language favoring a different examination than the one ordered).

Statistical Analysis

Descriptive statistics were performed. In addition, a binomial generalized linear model with recommendation adherence (yes/no) as the dependent variable and ambiguous language (yes/no) as the independent variable was performed to test whether ambiguous recommendation language correlated with recommendation adherence. Statistical significance was set *a priori* at $p<0.05$. All statistical analyses were performed in R version 4.4.0 using the tidyverse, janitor, and lme4 libraries.

RESULTS

Study Cohort and Characteristics

During the study period, a total of 5,109 temporal bone MRI examinations were performed and interpreted by 34 radiologists. Among these reports, 101 (2%) contained recommendations for temporal bone CT to confirm SSCD. Patients with recommendations had a median age of 55 years (Interquartile Range 43 to 67 years) and 60.4% (61/101) were female.

Among the radiologists, 32/34 (94.1%) had specialized training in neuroradiology and/or head and neck radiology, and 30/34 (88.2%) worked in academic settings. Radiologists had been out of training for a median of 12.5 years (Interquartile Range 5 to 25.8 years). Radiology trainees were involved in interpretation of 67.3% (68/101) of the examinations that included recommendations for a temporal bone CT.

Primary Outcomes

Only 22/101 (21.8%) patients recommended to have additional temporal bone CT examinations to assess for possible SSCD underwent these examinations. Among these 22 patients, 1 had solely vestibular/visual symptoms, 10 reported only auditory dysfunction, and the remaining 11 experienced a combination of both vestibular/visual symptoms and auditory dysfunction at the time of presentation.

Regarding these 22 CT examinations, 10/22 (45.5%) were reported as normal, 7/22 (31.8%) confirmed SSCD, and 5/22 (22.7%) equivocated on the presence of SSCD. A total of 19 patients had CT imaging of the bilateral ears and one patient had CT imaging of a single ear, for a total of 39 ears. The two reviewing neuroradiologists agreed on SSCD presence/absence in 37/39 (94.9% agreement; $k=0.88$). The neuroradiologists' consensus scores agreed that SSCD was not present in 10/10 (100%) of the examinations reported as normal, agreed that SSCD was present in 5/5 (100%) examinations for which the images were available where SSCD was definitively reported, and identified SSCD in 1/5 (20%) of the examinations where the CT report was equivocal for SSCD.

Among the 7 patients with confirmed SSCD findings on CT, only one was diagnosed with SSCD syndrome and this patient was managed conservatively. Three patients experienced improved symptoms, which were determined to be unrelated to SSCD. One patient was lost to follow-up with otology due to multiple other comorbidities. One patient presented with unilateral hearing loss, had SSCD reported on the other side, and the SSCD was deemed incidental and asymptomatic. None of the 22 patients underwent surgical intervention. Concise summaries of the clinical diagnoses and decisions for these 22 patients are provided in the Supplemental Data.

Among the 79 patients who did not have the follow-up CT, 40 (50.6%) recommendations were unacknowledged in the treating provider notes and 30 (29.7%) were acknowledged by the treating provider, who either disagreed or who discussed with the patient who declined. The remaining 9 (8.9%) patients had no additional notes in their chart after the CT report was issued and were effectively lost to follow-up. None of these patients were diagnosed with SSCD syndrome. A summary of the chart review, including direct quotes from the treating providers, is provided in the Supplemental Data.

Secondary Outcomes

None of the recommendations (0/101) met the criteria for actionable, while 76.2% (77/101) of the recommendations included ambiguous language. Recommendations with ambiguous language had 0.54 (95% CI: 0.19-1.6, $p=0.25$) lower odds of adherence compared to those without ambiguous language.

DISCUSSION

In this study of one year of temporal bone MRI examinations at a multi-institution healthcare center, only 22% of radiologist-recommended additional temporal bone CT examinations to confirm SSCD were performed, only 1 (1%) patient was determined to have SSCD syndrome, and this patient was managed conservatively.

In the context of the otology literature, these findings are largely not surprising. Ultimately, only about one-third of SSCD patients who are eligible for surgery choose to undergo the procedure.[2] In other words, corrective surgical techniques can be curative, but many patients may find their symptoms are not severe enough to warrant surgery. In children, SSCD syndrome frequently manifests with mild hearing loss and a watch-and-wait approach to treatment is common.[25] In adults, avoidance of environmental triggers that exacerbate symptoms may be sufficient. Although not fully understood, SSCD syndrome typically does not progress in most cases,[26] so decisions regarding intervention are often based primarily on symptom tolerance and surgical interventions are generally most effective in addressing auditory dysfunction and less effective in addressing other symptoms.[27] Furthermore, aside from symptoms such as sound/pressure-induced vertigo/oscillopsia, and bone-conducting hyperacusis, the otologic manifestations in SSCD syndrome are diverse and non-specific. These patients often present with a range of vestibular and auditory symptoms. Thus, SSCD is not typically considered a primary etiology for these non-specific symptoms from a broader clinical perspective. For example, patulous Eustachian tube and vascular causes including atherosclerosis are more commonly associated with pulsatile tinnitus,[28–30] while temporomandibular disorder Eustachian tube dilatory dysfunction frequently underly complaints of aural fullness[31] rather than SSCD. Hence, an incidentally questionable SSCD on MRI has a low likelihood of being a significant or primary contributor to the presenting otological symptoms, even if confirmed by temporal bone CT.

In addition, a CT examination may not provide substantially more information about suspected SSCD than temporal bone MRI. High resolution CT imaging is widely accepted as the primary imaging modality for identifying SSCD with a slice thickness of less than 1 mm (preferably 0.625 mm or less), and reformatted parallel to the plane of the superior semicircular canal (Pöschl view) and perpendicular to it (Stenvers view) to reduce partial volume averaging[32,33]. Nevertheless, the false positive rate remains high.[6,10] It has thus been advised against relying solely on CT for diagnosing SSCD syndrome,[34] with physiologic studies including cervical or ocular vestibular evoked myogenic potentials (cVEMP and oVEMP) needed to further confirm the diagnosis.[35,36]

In this study, recommendations containing ambiguous language had significantly lower odds (OR: 0.50, 95% CI: 0.26-0.98; p=0.04) of being performed than those that were unambiguous and none of the recommendations were actionable. These findings likely reflect radiologist uncertainty on whether these recommendations are clinically meaningful and the ambiguity is likely a deferral of the decision to the ordering provider. Given that most of these recommendations were not followed and those that were followed appear to have had no clinical impact, these recommendations likely lead to medical waste and unnecessary costs, patient anxiety, and unnecessary radiation.

This study has several limitations. The study reflects experience at a single healthcare system, so it may not be generalizable, though our system includes both academic and community radiologists across multiple institutions and practice settings. Similarly, the MRI and CT protocols were heterogeneous. The study sample size is also small but encompasses an entire year of examinations across a multi-institution healthcare system. Most treating providers did not clearly document whether patients did or did not have many of the array of symptoms associated with SSCD syndrome, so it was not possible to meaningfully study the associations of symptoms with SSCD or recommendation adherence, or to perform between-group comparisons. Finally, the follow-up period ranged from 2 to 3 years and therefore a small number of patients may have had the recommended CT examination after the follow-up period, but that is unlikely given that three-quarters of patients who underwent the recommended examination did so within 3 months.

CONCLUSIONS

Only 21.7% of recommendations for additional temporal bone CT examination in patients with questioned SSCD on temporal bone MRI were followed, and only one of 101 patients was diagnosed with SSCD clinical syndrome, which was managed conservatively. Therefore, radiologist recommendations for temporal bone CT in the setting of questionable superior semicircular canal dehiscence findings on MRI appear to have negligible clinical value. Thus it is likely most appropriate to report possible SSCD in the MRI report impression without recommending further imaging.

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SUPPLEMENTAL FILES

See appended pages.

Outcomes of Radiologist Recommendations for Temporal Bone CT to Assess Superior Semicircular Canal Dehiscence (SSCD) on Temporal Bone MRI

Supplemental Data

Supplemental Table 1: Summary information for the 22 patients who adhered to the temporal bone CT recommendation.

Adhering Subject ID	Days from Recommendation to CT	SSCD in Radiology Report	SSCD on Consensus Review	Clinical Summary
1	17	No	No	Normal vestibular testing, referred to neurology for vestibular migraine.
2	13	Yes	Yes	SSCD syndrome diagnosed. Surgery was offered but patient opted for conservative management. No return to otology for 2 years during study period.
3	114	Yes	Yes	Left SSCD considered not related to right sensorineural hearing loss.
4	203	Yes	Images Not Available	Diagnosed with improving benign positional paroxysmal vertigo. No further follow-up after CT.
5	75	No	No	"not a clear cut case - thin bone and some localizing signs and symptoms, but not all consistent with SCD." Surgery discussed but observation chosen. Dizziness persists 3 years later and patient stopped seeing otology.
6	72	No	No	Diagnosed with ear pressure from TMJ disorder. Symptoms improved over 1 year.
7	103	No	No	Diagnosed with migraine. Symptoms improved.
8	104	Equivocal	Yes	Likely related to chemotherapy and head trauma. Hearing aids recommended.
9	11	Yes	Yes	TMJ disorder, migraine, and stroke. SSCD not addressed given other morbidities.
10	14	Equivocal	No	"While there may be superior semicircular canal dehiscence on the right, this would not account for her bilateral symptoms in the absence of a conductive hearing loss, vertigo or Tullio phenomenon. The significance of the findings involving the right superior semicircular canal are unclear and this may very well represent an incidental finding. Given this, I recommended conservative observation with binaural amplification."
11	22	No	No	Diagnosed with BPPV by otology. Never again saw otology. Not mentioned in subsequent PCP notes.
12	26	No	No	Chronic otalgia with cerumen impaction. No SSCD.

13	210	Equivocal	No	"Right possible SCD - his symptoms are not specific to SCD except possibly the aural fullness. Recommended observation. Discussed options including surgery for SCD which would not be recommended. Deferred on VEMP since sx are not severe enough to warrant intervention."
Adhering Subject ID	**Days from Recommendation to CT**	**SSCD in Radiology Report**	**SSCD on Consensus Review**	**Clinical Summary**
14	42	Equivocal	Yes	SSCD never mentioned in otology notes. Cochlear implant placed.
15	1	Equivocal	Yes	Outside provider. No clinical notes.
16	35	Yes	Yes	Otologist recommended observation for tinnitus and vestibular therapy for vertigo. No further visits with ENT. Not again mentioned in PCP notes.
17	76	No	No	"Thin covering over the left superior canal is likely incidental and not associated with any symptoms. He has no symptoms of superior canal dehiscence." Observation recommended then lost to follow-up.
18	9	Yes	Yes	Outside provider. No clinical notes.
19	13	No	No	Tinnitus and vertigo in the absence of SSCD. Patient educated on symptom management and no further visits to otology.
20	45	No	No	Diagnosed with asymmetric sensorineural hearing loss. No return visit to otology. No PCP notes in our system.
21	428	Yes	Images Not Available	"Dizziness -likely multifactorial and this is not consistent with vertigo... Small fiber neuropathy contributed by diabetes is in the differential. MRI of the brain was unremarkable. CT of the temporal bones was unremarkable." Symptoms persist.
22	15	No	No	"No evidence of 3rd window. Left tinnitus with somatic component."

Outcomes of Radiologist Recommendations for Temporal Bone CT to Assess Superior Semicircular Canal Dehiscence (SSCD) on Temporal Bone MRI

Supplemental Data

Supplemental Table 2: Summary information for the 79 patients who did not adhere to the temporal bone CT recommendation.

Non-Adhering Subject ID	Action on Recommendation	Clinical Summary
1	Not Acknowledged	Diagnosed with tinnitus. Report with RAI included in ENT note but ENT note did not comment futher.
2	Disagreed/Declined	ENT Note: "You are correct that there rarely consequence if you have SCD and do nothing, and majority of the time, we don't advise intervention unless symptoms are severe (ear fullness, pulsation in ear, vertigo/sensitivity to loud noise). Intervention entails a craniotomy to plug that canal so we really only perform this surgery if patients are severely affected by their symptoms. So, I am fine with not proceeding with CT scan unless you feel you need to have a definitive diagnosis (CT and not MRI is able to really tell us a true dehiscence)." Patient then declined.
3	Not Acknowledged	Prior SSCD surgical repaired on contralateral side. No comment from ENT on this result. Referred to pain management for pain on side of prior surgery.
4	Not Acknowledged	Surgery 6 weeks later for chronic otitis media. Tegmen thin but no meningocele. SSCD not explored.
5	No Follow-up	No ENT or other physician notes since the MRI.
6	Not Acknowledged	ENT note included the RAI but did not mention further: "positional dizziness likely due to relapsing BPPV that has spontaneously resolved. No evidence of peripheral vestibular loss"
7	No Follow-up	No ENT or other physician notes since the MRI.
8	Not Acknowledged	ENT note included the RAI and immediately below stated: "I independently reviewed and interpreted the imaging testing data available in the EHR and shared my interpretation with the patient." ENT impression was: "Suspected VM [vestibular migraine]. Globally improving. MRI clear."
9	No Follow-up	Never saw ENT again. PCP notes have not commented.
10	Disagreed/Declined	Diagnosed with chronic migraine without aura. Report with RAI included in neurologist's note with comment that SSCD could be nonspecific and patient had 6 sessions of vestibular PT.
11	Disagreed/Declined	Patient has sensorineural hearing loss. ENT note has a comment to monitor her clinically.
12	Not Acknowledged	Patient has sudden sensorineural hearing loss. Report with RAI included in ENT note, but ENT note did not comment further.

Non-Adhering Subject ID	Action on Recommendation	Clinical Summary
13	No Follow-up	No ENT or other physician notes since the MRI.
14	Disagreed/Declined	Diagnosed with pulsatile tinnitus. Report with RAI included with comment by ENT: “He does have thinning of the SCC which may account for the symptom but has no other symptoms of SCCD syndrome."
15	Not Acknowledged	Presenting complaint for vertigo. ENT didn’t mention or comment on SCCD.
16	Disagreed/Declined	Presenting complaint of dizziness. RAI report included in ENT notes, and ENT commented "VEMP at that time was consistent with right SCD, although hearing was normal with no suprathreshold bone curves or air-bone gaps".
17	Disagreed/Declined	RAI report included in ENT notes. Patient was referred to otoneurologist. The otoneurologist diagnosed her with BPPV and commented:“Positional dizziness most consistent with subjective BPPV involving her right ear. Her symptoms are unlikely to be due to superior canal dehiscence. "
18	Disagreed/Declined	Past history of SSCD: Otoneurologist included the report with RAI but commented, "It's conceivable that the SCD is contributing to his difficulty compensating, but this is uncertain."
19	Not Acknowledged	History of left-sided aural fullness, pressure, and vertigo. ENT didn’t mention or comment on a thin bony covering over bilateral superior semicircular canals or the temporal CT recommendation.
20	No Follow-up	ENT agreed with the recommendation, and a temporal bone CT was ordered, but the order eventually expired.
21	Not Acknowledged	ENT discussed the MRI report with patient on the phone but did not comment on bony thinning overlying the bilateral superior semicircular canals.
22	No Follow-up	No follow-up visit with the ENT to discuss the MRI report or recommendation.
23	Not Acknowledged	ENT discussed the MRI report but didn’t comment on SCD.
24	Not Acknowledged	Diagnosed with neurosyphilis. Report with RAI included in ENT note, but ENT note did not comment further.
25	Not Acknowledged	Presenting complain was diziness. Report with RAI included in otoneurologist note but otoneurologist note did not comment futher.
26	Disagreed/Declined	Presenting complaint dizziness. Otoneurologologist commented this in notes:"If she develops pressure-induced dizziness or autophony, then further evaluation with CT of the temporals can be done." CT was never ordered. There was no follow-up with the otoneurologist.

27	Not Acknowledged	Diagnosed with Chronic eczematous otitis externa. Report with RAI included in ENT note but ENT note did not comment futher.
28	Disagreed/Declined	ENT commented "she does not exhibit symptoms consistent with superior semicircular canal dehiscence."
29	Not Acknowledged	Patient had Postconcussion syndrome. Report with RAI included in neurologist note but neurologist note did not comment futher.
Non-Adhering Subject ID	**Action on Recommendation**	**Clinical Summary**
30	Not Acknowledged	Diagnosed with Dandy syndrome (bilateral peripheral vestibular hypofunction). Report with RAI included in otoneurologist note but otoneurologist note did not comment futher.
31	Not Acknowledged	Incidentally diagnosed pineal cyst. Report with RAI included in neurosurgeon note but neurosurgeon note did not comment futher.
32	Disagreed/Declined	ENT discussed thinning of the bone over the superior canal but commented "not a frank or definite dehiscence". The patient is trying to conceive, so the ENT opted for cervical VEMP instead of a CT scan.
33	Not Acknowledged	Primary care physician called the patient to discuss the results of MRI but did not comment on SCD.
34	Disagreed/Declined	The ENT declined the recommendation based on this comment in the notes: “Although the MRI suggests possible semicircular canal dehiscence, the patient does not experience significant symptoms of unsteadiness or conductive hearing loss.”
35	Not Acknowledged	No follow-up visit with the ordering neurologist to discuss the MRI report or recommendation.
36	Not Acknowledged	The patient presented with sudden hearing loss. The ENT administered an intratympanic steroid injection. However, the ENT did not discuss superior canal dehiscence or CT recommendation.
37	Disagreed/Declined	The ENT sent a message to the patient regarding SCCD on an MRI and the ENT isnt sure if ct is needed. The patient was then asked if they would like to proceed with a CT scan. Patient’s response to this question is not documented, and the CT scan was not ordered.
38	Disagreed/Declined	ENT commented " however no associated symptoms to suggest superior semicircular canal dehiscence syndrome Reassured no follow up needed"
39	Not Acknowledged	CPAP follow-up. The report with RAI is included in the ENT note, but the ENT note does not provide any further comments.
40	Disagreed/Declined	According to an otoneurologist, there is no indication that a follow-up CT scan is necessary.

41	Not Acknowledged	Patient had chronic, symmetric, progressive binaural hearing loss of presbycusis. The ENT discussed the MRI. But did not comment on RAI or semicircular canals thinning.
42	Not Acknowledged	Diagnosed with tinnitus. Report with RAI included in ENT note but ENT note did not comment futher.
43	Disagreed/Declined	ENT comments:" Report notes possible right SSCD, but no audiometric or history findings to support this and would not pursue CT scan at this time in the absence of symptoms. "
44	Disagreed/Declined	ENT comments: "We discussed incidental finding of possible thinning over superior canals. However, she does not have any symptoms consistent with superior canal dehiscence and will therefore observe at this time."
Non-Adhering Subject ID	**Action on Recommendation**	**Clinical Summary**
45	Not Acknowledged	Referred by ENT to neurosurgeon for pineal cyst. Report with RAI included in neurosurgeon's note, but neurosurgeon's note mentioned SCD but did not comment further on the CT recommendation.
46	Not Acknowledged	Allergist reported with RAI included in note, mentioned SCD but did not comment further on the CT recommendation.
47	Not Acknowledged	Presenting complaint imbalance. The nerologist called MRI scan of the brain is unremarkable and didn't comment on semicircular canals findings.
48	Not Acknowledged	The patient had dizziness. The ENT and neurologist included the report with RAI. But didn't comment further on it.
49	Disagreed/Declined	ENT comment: "Possible SSCD noted but MRI not definitive for this and he does not have symptoms of SSCD. If these develop, dedicated CT temporal bone would be needed."
50	Not Acknowledged	Diagnosed with peripheral vestibulopathy Report with RAI included in ENT note but ENT note did not comment futher.
51	Not Acknowledged	Patient had left-sided sensorineural hearing loss. MRI results were discussed by the ENT. However, semicircular canals thinning was not discussed.
52	Not Acknowledged	ENT comments: "No evidence of a retrocochlear abnormality. Possible left superior semicircular canal dehiscence does not explain her symptoms and is likely incidental if present. Would not obtain any further imaging at present time."
53	Disagreed/Declined	ENT ruled out SCCD on the basis of previous (2017 CT) commenting: Referral to MGH neurology for arachnoid cyst. CT did not demonstrate dehiscence.

54	Disagreed/Declined	ENT discussed the right possible superior semicircular canal dehiscence and scant mastoid opacification on the left mastoid, which appears stable compared to prior MRI scan from 2009. ENT commented: I don’t believe she has clinically significant right superior semicircular canal dehiscence. "
55	Disagreed/Declined	ENT comments: "I do not believe a CT scan of the temporal bone is warranted given that she denies the majority of SSCD symptomotology."
56	Disagreed/Declined	ENT comments: "There is an incidental finding of thin bone over the superior semicircular canal on 1 side but this is not clinically relevant to her symptoms and is just an incidental finding." ENT did not comment further on temporal CT recommendation.
57	Disagreed/Declined	Presenting complaint of dizziness. Report with RAI included in ENT note, ENT note commented on the SCC thinning that it is not contributing to imbalance but didn’t comment on the CT recommendation.
Non-Adhering Subject ID	**Action on Recommendation**	**Clinical Summary**
58	Disagreed/Declined	Patient has hearing loss in the right ear. The ENT did not discuss possible SCCD. The report with RAI is included in the ENT note, but the ENT note did not comment further.
59	Disagreed/Declined	ENT ruled out acoustic neuroma. Report with RAI included in ENT note but ENT note did not comment futher.
60	Not Acknowledged	Diagnosed with Meniere disease. Report with RAI included in ENT note but ENT note did not comment futher.
61	Not Acknowledged	Patient had sudden sensorineural hearing loss. ENT note mentioned on the SCC thinning that but didn’t comment on the CT recommendation.
62	Not Acknowledged	Presenting complaint hearing loss.Report with RAI included in ENT note but ENT note did not comment futher.
63	Disagreed/Declined	ENT comment:"I don't recommend w/u for SCD as he is asymptomatic so would not affect management."
64	Disagreed/Declined	ENT comment: " MRI obtained for tinnitus. No evidence of retrocochlear abnormality. No concern for clinical signs of superior canal dehiscence."
65	No Follow-up	There was no follow-up after the MRI with the ENT.
66	Not Acknowledged	ENT comments: "Discussed thin covering of bone that was mentioned. She would return for any further/new symptoms."

67	Not Acknowledged	Chronic nasal obstruction. MRI was not discussed, and the ENT didn't comment on possible SCCD or ct recommendation.
68	Not Acknowledged	Patient had chronic recurring dizziness . Report with RAI included in otoneurologist note but otoneurologist note did not comment futher.
69	Disagreed/Declined	ENT coments: "Given she has no symptoms indicative of SCD, we decided to defer on CT imaging."
70	Disagreed/Declined	Discussed MRI findings of thinning of SCC with the patient and ruled out SCCD based on the patient's symptoms.
71	Disagreed/Declined	ENT discussed with the patient possible SCCD and ruled out CT recommendation based on the patient's lack of specific symptoms
72	Not Acknowledged	Presenting complaint of vertigo. Report with RAI included in otoneurologist note but otoneurologist note did not comment futher.
73	No Follow-up	No follow-up on MRI findings with the otoneurologist.
74	No Follow-up	No follow-up on MRI findings with the ordering ENT.
75	Not Acknowledged	ENT discussed MRI with the patient but ENT note did not comment futher on SCC and CT recommendation.
76	Disagreed/Declined	ENT discussed specific symptoms, and the patient had no pulsatile tinnitus or noise-induced vertigo. Therefore, the ENT decided to hold on further evaluation unless the patient became symptomatic.
Non-Adhering Subject ID	**Action on Recommendation**	**Clinical Summary**
77	Not Acknowledged	Patient had Dizziness. Report with RAI included in otoneurologist note but otoneurologist note did not comment futher.
78	Not Acknowledged	The ENT sent a message to the patient's MRI, stating that there were no concerning findings.
79	Not Acknowledged	The ENT mentioned the thinning of the SCC but didn't comment on the CT recommendation.