SUPPLEMENTARY INFORMATION

Supplementary Methods

Etiology of Failure Definitions:

1) **Ossicular discontinuity/incus erosion**
    a. Ossicle in contact with the prosthesis has lost attenuation which appears to be resulting in discontinuity or mal-position of the prosthesis
2) **Prosthesis is displaced from the ossicular chain or oval window**
    a. The lateral portion of the prosthesis is not making appropriate contact with the intended ossicle or clearly not making contact with the oval window
    b. This answer is selected if there is displacement of the ossicular chain without Option 1 clearly being present
3) **Depth of insertion too deep**
    a. No formal measurement used
    b. Appropriately seated prosthesis in continuity with ossicles but too deep
    c. The purpose of this answer choice is to capture if the surgeon chose a prosthesis that was too long
4) **Depth of insertion too shallow**
    a. No formal measurement used
    b. Appropriately seated prosthesis in continuity with ossicles but too short
    c. Do not select this answer if the prosthesis appears to be impinging on the oval window or is displaced from the oval window
    d. The purpose of this answer choice is to capture if the surgeon chose a prosthesis that was too short
5) **Obliterative Otosclerosis**
    a. Subjectively, if the footplate looks thickened, especially in its central segment (not just anterior portion) AND this finding appears to be hindering appropriate mobility of the prosthesis
    b. No formal measurement used
6) **Prosthesis impingement on wall of oval window**
    a. The prosthesis is abutting the footplate/oval window. It is still likely within the vestibule.
    b. Do not select this answer if the prosthesis is clearly NOT within the oval window. You would select “prosthesis is displaced from oval window” in those cases
    c. If obliterative otosclerosis appears to be contributing, then select Option 5
7) **Prosthesis appears appropriately placed, No obvious cause**
    a. Negative study, no clear of suggestive cause of failure
8) **Other**

Table S1

STARD 2015 Checklist for the Reporting of Studies of Diagnostic Accuracy

Comparison of photon-counting CT and energy-integrating detector CT in the evaluation of failed primary stapes surgery. Based on the STARD 2015 list (Bossuyt et al, Radiology 2015;277:826-832). Location references correspond to the manuscript section indicated; where an item does not apply to this comparative reader study, “NA” is given with a brief rationale.

Section / Topic	#	Item	Location in manuscript
Title or Abstract	1	Identification as a study of diagnostic accuracy using at least one measure of accuracy (such as sensitivity, specificity, predictive values, or AUC).	Title; Abstract. Identified as a diagnostic-accuracy comparison of two CT techniques, with diagnostic accuracy against an intraoperative reference standard as a stated measure.
Abstract	2	Structured summary of study design, methods, results, and conclusions (for specific guidance, see STARD for Abstracts).	Abstract. Structured under Background and Purpose, Materials and Methods, Results, and Conclusions.
INTRODUCTION			
	3	Scientific and clinical background, including the intended use and clinical role of the index test.	Introduction. Background on otosclerosis, revision stapes surgery, and the role of pre-revision CT; intended use of CT (and of PCCT) to identify causes of failure and guide revision planning is stated.
	4	Study objectives and hypotheses.	Introduction, final paragraph. Explicit study purpose and null/alternative hypothesis (PCCT would show superior accuracy, confidence, and interobserver agreement vs EID-CT).
METHODS			
Study design	5	Whether data collection was planned before the index test and reference standard were performed (prospective study) or after (retrospective study).	Methods, first paragraph and “Imaging.” Retrospective study; imaging and revision surgery were performed as routine clinical care prior to data collection.
Participants	6	Eligibility criteria.	Methods, “Patient Selection.” Inclusion and exclusion criteria fully specified, including the success definitions used to confirm the reference standard.
	7	On what basis potentially eligible participants were identified (such as symptoms, results from previous tests, inclusion in registry).	Methods, “Patient Selection.” Identified on the basis of having undergone failed primary stapes surgery followed by successful revision stapedotomy with a pre-revision CT.
	8	Where and when potentially eligible participants were identified (setting, location and dates).	Methods, “Patient Selection” and “Imaging.” Single tertiary-care institution (revision surgery site); CT imaging performed between 2015 and 2025; EID-CT also drawn from outside referring institutions.

Section / Topic	#	Item	Location in manuscript
	9	Whether participants formed a consecutive, random or convenience series.	Methods, “Patient Selection.” Consecutive eligible patients meeting the stated criteria over the study period; no further selection applied.
Test methods	10a	Index test, in sufficient detail to allow replication.	Methods, “Imaging.” Full PCCT acquisition parameters (scanner, mode, kVp, slice thickness, detector configuration, IQ level, pitch, rotation time, CTDIvol, reconstructions) provided; EID-CT slice-thickness range and median given, number of external and internal studies, with heterogeneity of outside protocols acknowledged.
	10b	Reference standard, in sufficient detail to allow replication.	Methods, “Patient Selection” and “Statistical Methods.” Intraoperative findings at revision stapes surgery served as the reference standard.
	11	Rationale for choosing the reference standard (if alternatives exist).	Methods, “Statistical Methods,” and Discussion (limitations). Direct surgical confirmation chosen as the most reliable reference standard; trade-offs (spectrum/case-selection bias) discussed.
	12a	Definition of and rationale for test positivity cut-offs or result categories of the index test, distinguishing pre-specified from exploratory.	Methods, “Imaging Interpretation and Consensus Process,” and Supplement 2. Pre-specified discrete etiologic categories with standardized imaging definitions; no numeric cut-off used for insertion depth (rationale: no consensus reference value). Etiology-specific accuracy analyses labeled exploratory in “Statistical Methods.”
	12b	Definition of and rationale for test positivity cut-offs or result categories of the reference standard, distinguishing pre-specified from exploratory.	Methods, “Imaging Interpretation and Consensus Process” and “Patient Selection.” Reference-standard etiologic categories were the same pre-specified surgical findings; success definitions confirming a valid reference standard are pre-specified.
	13a	Whether clinical information and reference standard results were available to the performers/readers of the index test.	Methods, “Imaging Interpretation and Consensus Process.” Readers had basic clinical background but were blinded to intraoperative findings, clinical outcomes, official reads, and each other. Modality could not be masked (limitation); the neurotologist had cared for 2 of 38 patients.
	13b	Whether clinical information and index test results were available to the assessors of the reference standard.	NA / not applicable. The reference standard was the operative finding recorded during clinical care; no separate blinded reference-standard adjudication of the index test was performed. The operating surgeon necessarily had access to clinical information.
Analysis	14	Methods for estimating or comparing measures of diagnostic accuracy.	Methods, “Statistical Methods.” Accuracy compared with the Fisher exact test; interpreter confidence with the Mann-Whitney U test; interobserver agreement with Fleiss kappa; 95% confidence intervals reported; significance threshold $p<0.05$.
	15	How indeterminate index test or reference standard results were handled.	Results, “Diagnostic Accuracy” and Table 3. No indeterminate reads occurred; discrepant reader

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			interpretations were resolved by joint consensus review (Methods).
	16	How missing data on the index test and reference standard were handled.	Results, “Diagnostic Accuracy” and Table 3. No missing index-test or reference-standard data; one etiology (pneumolabyrinth/perilymphatic fistula) had no PCCT cases, denoted “ND” in Table 3.
	17	Any analyses of variability in diagnostic accuracy, distinguishing pre-specified from exploratory.	Methods, “Statistical Methods,” and Results (Tables 2-4). Per-reader accuracy and etiology-specific accuracy analyses are labeled exploratory; interobserver-agreement analysis by modality was pre-specified.
	18	Intended sample size and how it was determined.	No a priori sample-size or power calculation was performed; all eligible patients over the study period were included.
RESULTS			
Participants	19	Flow of participants, using a diagram.	Provided as a STARD participant flow diagram (see accompanying figure below): 49 identified, 11 excluded for not meeting the improvement criterion, 38 included (18 PCCT, 20 EID-CT), all with both index test and reference standard.
	20	Baseline demographic and clinical characteristics of participants.	Results, “Patients,” and Table 1. Age, sex, and group sizes by modality; all patients underwent middle ear exploration with revision stapes surgery.
	21a	Distribution of severity of disease in those with the target condition.	Results, “Diagnostic Accuracy,” Table 3, and Supplement 2. Distribution of etiologies of failure (the target conditions) reported by category across the cohort.
	21b	Distribution of alternative diagnoses in those without the target condition.	Results, Table 3. The “prosthesis appears appropriately placed, no obvious cause” category captures cases without an identifiable causative target condition.
	22	Time interval and any clinical interventions between index test and reference standard.	The interval between pre-revision CT and revision surgery was not systematically reported. No intervention altering the target findings was administered between imaging and revision.
Test results	23	Cross tabulation of the index test results (or their distribution) by the results of the reference standard.	Results, “Diagnostic Accuracy,” Tables 2 and 3. Reader and consensus interpretations cross-tabulated against the intraoperative reference standard by etiology and by modality.
	24	Estimates of diagnostic accuracy and their precision (such as 95% confidence intervals).	Results, “Diagnostic Accuracy” and “Inter-observer Agreement,” Tables 2-4. Per-reader and consensus accuracy with p-values; Fleiss kappa estimates with 95% confidence intervals.
	25	Any adverse events from performing the index test or the reference standard.	NA. No adverse events attributable to the index test (non-contrast CT) or the reference standard

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			(revision surgery) were within the scope of this retrospective imaging study.
DISCUSSION			
	26	Study limitations, including sources of potential bias, statistical uncertainty, and generalizability.	Discussion, limitations paragraph. Small/underpowered sample; spectrum/case-selection bias; non-contemporaneous cohorts with heterogeneous outside EID-CT protocols; inability to mask modality (expectation bias).
	27	Implications for practice, including the intended use and clinical role of the index test.	Discussion and Conclusion. Clinical relevance of improved interobserver agreement for multidisciplinary decision-making and surgical planning; role of PCCT to standardize interpretation.
OTHER INFORMATION			
	28	Registration number and name of registry.	NA. This retrospective study was not registered in a clinical trial registry; the IRB determination (ID 25-012840) is reported in Methods.
	29	Where the full study protocol can be accessed.	NA. No separately published protocol.
	30	Sources of funding and other support; role of funders.	No external funding

STARD, Standards for Reporting of Diagnostic Accuracy Studies (2015 update). PCCT, photon-counting CT; EID-CT, energy-integrating detector CT; AUC, area under the ROC curve; NA, not applicable. Supplement 2 refers to the Etiology of Failure Definitions provided as supplementary material. Items marked [AUTHOR INPUT NEEDED] require confirmation or a brief manuscript addition before submission.

Table S2

Energy-Integrating Detector Acquisition Parameters

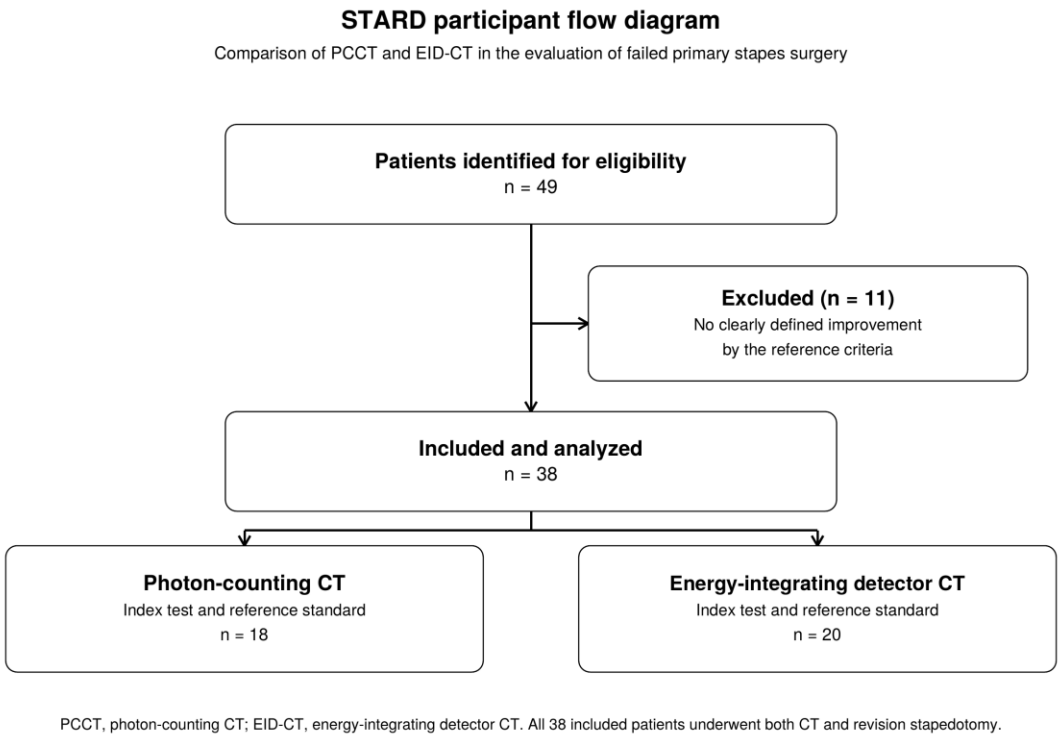
Internal vs External	Slice thickness (mm)	kVp	mAs	Scanner	FOV (mm)	Pitch	Kernel
Internal	0.5	120	500	Toshiba (Aquilion ONE)	90	unlisted	FC81
Internal	0.5	120	400	Siemens (Sensation 64)	80	unlisted	U70u
Internal	0.4	120	360	Siemens (Somatom Force)	80	unlisted	Ur77u\3
Internal	0.625	120	9	GE (Discovery CT750 HD)	100	0.53125	BONEPLUS2
Internal	0.4	120	400	Siemens (Somatom Force)	80	0.35	Ur77u\3
Internal	0.5	120	280	Seimens (Somatom Definition Flash)	104	0.8	Ur70u\1
Internal	0.4	120	400	Siemens (Somatom Force)	90	0.35	Ur77u\3
Internal	0.4	120	348	Siemens (Somatom Force)	80	0.35	Ur77u\3
Internal	0.4	120	400	Siemens (Somatom Force)	80	0.35	Ur77u\3
Internal	0.4	120	402	Siemens (Somatom Force)	80	0.35	Ur77u\3
External	1	120	100	Toshiba (Aquilion)	95.625	0.688	FC30
Internal	0.4	120	425	Siemens (Somatom Force)	80	0.35	Ur77u\3
Internal	0.625	120	9	GE (Discovery CT750 HD)	100	0.53125	BONEPLUS2
Internal	0.4	120	400	Siemens (Somatom Force)	80	0.35	Ur77u\3

External	0.625	120	7	GE (LightSpeed VCT)	100	0.53125	BONEPLUS
Internal	0.5	120	750	Toshiba (Aquilion ONE)	90	unlisted	FC81
Internal	0.4	120	428	Siemens (Somatom Force)	80	0.35	Ur77u\3
Internal	0.4	120	377	Siemens (Somatom Force)	80	0.35	Ur77u\3
Internal	0.4	120	382	Siemens (Somatom Force)	80	0.35	Ur77u\3
Internal	0.4	120	328	Siemens (Somatom Force)	100	0.35	Ur77u\3

EID-CT, energy-integrating detector CT; kVp, kilovoltage peak; mAs, milliampere-seconds; FOV, field of view. “Internal” denotes examinations performed at the authors’ institution and “External” those performed at outside referring institutions.

Figure S1

STARD Participant Flow Diagram (Item 19)



PCCT, photon-counting CT; EID-CT, energy-integrating detector CT. All 38 included patients underwent both CT and revision stapedotomy.