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Nondiagnostic Cytology and Recorded Subsequent Care after Ultrasound-Guided Thyroid Fine-Needle Aspiration

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Abstract

Background: Nondiagnostic thyroid fine-needle aspiration (FNA) can prompt further assessment, but a repeat-biopsy plan does not establish diagnostic resolution. We described index cytology and recorded subsequent care in a community-hospital sample. **Methods:** This retrospective quality-assurance study included 96 patients with index FNA during January 2022-October 2025. Case identification combined randomly generated dates with first-listed eligible patient selection. The index procedure was the first FNA within the study period; the largest biopsied nodule was analyzed. The routine protocol used a 25-gauge needle and three passes without rapid on-site evaluation. Records were reviewed through December 2025. The primary outcome was the nondiagnostic proportion in the reviewed sample. **Results:** Index cytology was nondiagnostic in 26/96 index nodules (27.1%). Among the 26 patients with nondiagnostic index-nodule cytology, 17 had repeat biopsy listed as management and 12 had available same-nodule repeat cytology: seven benign and five nondiagnostic results. Six patients had no further FNA recorded. Thyroid surgery was recorded in 10/96 patients. Twelve biopsied nodules fell outside routine American College of Radiology Thyroid Imaging Reporting and Data System category-and-size criteria; three yielded malignant cytology. Eighty-four index procedures (87.5%) occurred in 2022. **Conclusion:** Nondiagnostic cytology was frequent in this selected sample, supporting review of sampling, specimen processing, and documentation of subsequent assessment. First-listed patient selection, the predominance of 2022 index procedures, and incomplete follow-up limit inference about service-wide performance and complete diagnostic resolution.

Keywords

Thyroid Nodule, Fine-Needle Aspiration, Nondiagnostic Cytology, Quality

Assurance, ACR TI-RADS

1. Introduction

Fine-needle aspiration (FNA) is used to obtain cytologic material from a thyroid nodule to help characterize the lesion. While ultrasound can identify features associated with an increased risk of malignancy, imaging alone cannot reliably establish a tissue diagnosis. FNA therefore serves as the principal diagnostic step for appropriately selected nodules and helps guide subsequent management. The American Thyroid Association (ATA) guidelines and American College of Radiology Thyroid Imaging Reporting and Data System (ACR TI-RADS) guide biopsy selection using sonographic findings and clinical context [1] [2]. The clinical value of this pathway depends on obtaining an informative specimen and documenting an appropriate response to the result.

Nondiagnostic cytology leaves the initial assessment incomplete. Repeat aspiration can provide a more informative result, but some samples remain nondiagnostic and some patients follow alternative clinical pathways. ATA guidance recommends ultrasound-guided repeat FNA after an initial nondiagnostic result, with on-site cytologic evaluation when available [1]. Evidence that rapid on-site evaluation (ROSE) can improve adequacy, particularly where baseline adequacy is lower, provides a rationale for reviewing local sampling and processing practices [3].

We conducted a retrospective quality-assurance study of ultrasound-guided thyroid FNA at Lakeridge Health. Our primary objective was to estimate the nondiagnostic proportion in the reviewed sample and assess whether further investigation regarding the clinical utility of FNA is indicated. Secondary objectives were to describe subsequent care after nondiagnostic cytology, thyroid surgery across index cytology groups, and the relationship between biopsied nodules and routine ACR TI-RADS category-and-size criteria.

2. Methods

2.1. Study Design and Selection

We conducted a retrospective observational quality-assurance study of ultrasound-guided thyroid FNA at one community hospital within Lakeridge Health, Ontario, Canada. The study period was January 2022-October 2025. Case identification used the procedure lists for ultrasound-guided thyroid FNA during this period.

The inclusion criteria were age 18 years or older, first thyroid FNA biopsy, and availability of follow-up data regarding FNA results. Exclusion criteria were incomplete medical records and loss to follow-up after FNA with respect to pathology results.

For each case-selection attempt, a random-number generator selected a year from 2022-2025 and an ordinal day from 1 - 365, with the 2025 range restricted to eligible dates through October. If no eligible FNA occurred on the generated date,

the year-and-day draw was repeated. When several eligible patients were listed, the first patient on the procedure list was selected. If a patient had already been selected, the entire randomization and selection process was repeated to obtain a different patient. Each attempt used a fresh draw. This procedure randomized dates but did not constitute simple random sampling of patients.

Each selected patient contributed one index record. The FNA performed on the randomly generated date had to be the patient's first FNA and was the index procedure analyzed. When several nodules were sampled at that procedure, the largest biopsied nodule was selected. Index dimensions, reported ACR TI-RADS category, and cytology referred to that nodule. Repeat cytology results referred to the same nodule selected for the index analysis and were summarized separately.

Of 100 date-based selection draws, 96 yielded unique patient records and four identified previously selected patients. Each included patient contributed one selected index nodule from the first FNA, and all 96 records were analyzed.

Aditya Pandya abstracted electronic medical and institutional imaging records using a standardized template. Records were reviewed through December 2025. Variables included age, sex, indication for initial thyroid ultrasound, FNA date, nodule dimensions, reported ACR TI-RADS category, cytology, subsequent investigations, and surgical management. Maximum diameter was the largest recorded dimension.

2.2. Procedure and Cytologic Assessment

Interventional radiologists performed ultrasound-guided FNA. The routine hospital protocol specified a 25-gauge needle and three passes per nodule. A pathologist assessed the specimens after the sample was sent to their lab and ROSE was not used.

Cytologic diagnoses were abstracted directly from the original pathology reports using the recorded Bethesda System for Reporting Thyroid Cytopathology categories; categories were not retrospectively mapped [4]. The six diagnostic categories were nondiagnostic (I), benign (II), atypia of undetermined significance (AUS; III), follicular neoplasm (IV), suspicious for malignancy (V), and malignant (VI). For descriptive presentation, index cytology results were summarized as nondiagnostic (I), benign (II), indeterminate (III), and malignant (VI). In this study, "indeterminate" referred specifically to AUS (Bethesda category III). The primary outcome was nondiagnostic cytology (Bethesda category I), and repeat cytology was classified using the same reporting system. Malignant cytology was not equated with histologically confirmed primary thyroid cancer. Category-specific malignancy risks were not estimated because histologic diagnoses were not captured systematically.

2.3. Outcomes and Subsequent Care

The primary outcome was the proportion of selected index nodules with nondiagnostic cytology, with one nodule analyzed per patient (n = 96). Secondary descriptive outcomes were index cytology distribution, recorded care after a nondi-

agnostic result, available repeat cytology, recorded thyroid surgery, and concordance with routine ACR TI-RADS category-and-size criteria.

For patients with nondiagnostic index cytology, records through December 2025 were abstracted to characterize subsequent care. Repeat-biopsy plans, monitoring, thyroid surgery, and the absence of further FNAs were all recorded. Deaths identified during record review were documented separately. When repeat biopsy was listed as the next management step, the corresponding entries were reviewed for cytology results, cancellation, a pending procedure, ultrasound reassessment without aspiration, or an unavailable result. This allowed for a description of both the intended management and the subsequent assessment documented in the record.

Repeat cytology was summarized for the same selected index nodule. Same-nodule correspondence was established using the recorded imaging dimensions.

Surgery was classified as recorded, not recorded, or status unavailable. Repeat-procedure dates and last clinical follow-up dates were not systematically abstracted. We therefore summarized the available same-nodule repeat results without estimating time to reassessment, completion within a fixed interval, or cumulative diagnostic resolution for the entire initially nondiagnostic group.

2.4. Comparison with Routine ACR TI-RADS Criteria

We compared each nodule's reported ACR TI-RADS category and maximum diameter with routine FNA recommendations: no routine FNA for TR2, and minimum diameters of 2.5 cm for TR3, 1.5 cm for TR4, and 1.0 cm for TR5 [2]. Nodules exactly at the threshold met the size criterion. We summarized cytology in biopsied nodules outside these category-and-size criteria.

This comparison did not adjudicate clinical appropriateness. Previous biopsy findings, FDG avidity, and other clinical circumstances may modify management [5]. Only biopsied nodules were included, so outcomes among nodules for which FNA was deferred could not be assessed.

2.5. Statistical Analysis

Categorical variables were summarized as counts and percentages with explicit denominators. Continuous variables were summarized as mean and sample standard deviation or median and interquartile range. The nondiagnostic proportion was accompanied by a Wilson 95% confidence interval; proportions among available repeat results used two-sided exact binomial intervals. These are unweighted binomial intervals conditional on the analyzed sample, not design-based estimates of service-wide precision. They do not account for selection bias, shared procedure dates, or incomplete outcome ascertainment. The analysis was descriptive, without hypothesis testing or adjusted comparisons. Inclusion probabilities could not be reconstructed, precluding sampling weights.

All 96 index records were analyzed under unique study identifiers. **Table 1** characteristics were available for all records. Missing repeat results and unavaila-

ble surgical status were reported explicitly. The reported analyses used Python with NumPy and SciPy.

Table 1. Patient and nodule characteristics.

Characteristic	Value
Patients, n	96
Selected index nodules, n	96
Age available, n	96
Age, mean ± SD, years	58.8 ± 14.2
Age, median (IQR), years	61 (50 - 67)
Female sex, n (%)	77 (80.2)
Maximum nodule diameter, mean ± SD, cm	2.40 ± 0.99
Maximum diameter, median (IQR), cm	2.3 (1.6 - 3.0)
Index-nodule ACR TI-RADS category, n (%)	
TR2	2 (2.1)
TR3	14 (14.6)
TR4	50 (52.1)
TR5	30 (31.3)
Year of index FNA, n (%)	
2022	84 (87.5)
2023	8 (8.3)
2024	1 (1.0)
2025	3 (3.1)

SD, standard deviation; IQR, interquartile range; ACR TI-RADS, American College of Radiology Thyroid Imaging Reporting and Data System; FNA, fine-needle aspiration. Maximum diameter is the largest recorded nodule dimension. All listed characteristics were available for all 96 patients. Nodule measurements and ACR TI-RADS categories refer to one selected index nodule per patient.

2.6. Ethics

This retrospective study was approved by the Lakeridge Health Research Ethics Board (REB no. 2025-008; approval date: June 5, 2025). The requirement for individual informed consent was waived by the Lakeridge Health Research Ethics Board for this retrospective review of existing medical records. The study involved reviewing existing medical records and did not alter clinical care. Patient data were coded, and direct identifiers were excluded from analysis outputs.

2.7. Reporting Guideline

Reporting was guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement, using the cohort checklist for this ret-

rospective observational quality-assurance study with review of subsequent care [6]. The item-by-item reporting checklist is provided as Supplementary Material S1. This study describes recorded care rather than evaluating an implemented quality-improvement intervention.

3. Results

3.1. Patient and Nodule Characteristics

The cohort comprised 96 patients, including 77 women (80.2%). Mean age was 58.8 ± 14.2 years. Median maximum nodule diameter was 2.3 cm (IQR, 1.6 - 3.0 cm). Recorded ACR TI-RADS categories were TR2 in two nodules, TR3 in 14, TR4 in 50, and TR5 in 30. Eighty-four index procedures (87.5%) occurred in 2022, eight in 2023, one in 2024, and three in 2025 (**Table 1**).

One selected index nodule was analyzed per patient; the largest biopsied nodule was selected when multiple nodules were sampled. The number of patients with more than one nodule sampled at the index procedure was not recorded.

3.2. Index Cytology

Index cytology of the 96 selected nodules was benign in 58 nodules (60.4%), nondiagnostic in 26 (27.1%), indeterminate in five (5.2%), and malignant in seven (7.3%). The nondiagnostic proportion was 27.1% (descriptive Wilson 95% binomial confidence interval conditional on the reviewed sample, 19.2% - 36.7%).

3.3. Care after Nondiagnostic Cytology

Repeat biopsy was listed as management for 17/26 patients with nondiagnostic index-nodule cytology (65.4%). Same-nodule repeat cytology was available for 12/17 index nodules in patients listed for repeat biopsy (70.6%), equivalent to 12/26 initially nondiagnostic index nodules (46.2%). Among these 12 nodules, repeat cytology was benign in seven (58.3%; exact 95% CI, 27.7% - 84.8%) and remained nondiagnostic in five (41.7%; exact 95% CI, 15.2% - 72.3%). These descriptive binomial intervals are conditional on the available same-nodule repeat results; they do not describe all nodules in patients referred for repeat biopsy.

The other five repeat-biopsy listings comprised two cancelled procedures, one pending procedure, one ultrasound reassessment without recommended FNA, and one unavailable repeat result. Among the nine patients without a repeat-biopsy listing, six had no further FNA recorded, one had monitoring recorded, one had surgery recorded, and one had died by review (**Table 2**).

3.4. Documented Thyroid Surgery

Thyroid surgery was recorded in 10 patients: five of five with indeterminate index cytology, four of seven with malignant cytology, and one of 26 with nondiagnostic cytology. No surgery was recorded among the 58 patients with benign index cytology. Overall, 84 patients had no surgery recorded, and surgical status was unavailable for two (**Table 3**). Completion thyroidectomy was listed as subsequent

Table 2. Subsequent care after nondiagnostic index cytology.

Management or result	n/N	%
Recorded management or status after index FNA		
Repeat biopsy listed as subsequent management	17/26	65.4
No further FNA recorded	6/26	23.1
Monitoring of the thyroid nodule	1/26	3.8
Surgery recorded	1/26	3.8
Death recorded	1/26	3.8
Entries among patients listed for repeat biopsy		
Benign repeat cytology	7/17	41.2
Nondiagnostic repeat cytology	5/17	29.4
Procedure cancelled	2/17	11.8
Procedure pending	1/17	5.9
Ultrasound reassessment without recommended FNA	1/17	5.9
Repeat result unavailable	1/17	5.9

FNA, fine-needle aspiration. The two sections describe overlapping stages and should not be added together. No further FNA denotes records coded No treatment and does not establish absence of other care. A repeat-biopsy listing does not establish completed aspiration. Repeat cytology from the same index nodule was available for 12/17 listed patients and 12/26 patients with nondiagnostic index-nodule cytology. Among those 12 results, seven were benign (58.3%; exact 95% CI, 27.7% - 84.8%) and five remained nondiagnostic (41.7%; exact 95% CI, 15.2% - 72.3%). Missing procedure dates and later outcomes prevent assessment of timely or complete diagnostic resolution. Management and status are patient-level observations; repeat cytology refers to the selected index nodules. The binomial intervals are descriptive and conditional on the available repeat results.

Table 3. Index cytology and documented thyroid surgery.

Index cytology	Patients n (%)	Surgery recorded	No surgery recorded	Status unavailable
Benign	58 (60.4)	0	58	0
Nondiagnostic	26 (27.1)	1	24	1
Indeterminate	5 (5.2)	5	0	0
Malignant	7 (7.3)	4	2	1
Total	**96 (100.0)**	**10**	**84**	**2**

Percentages in the patient column use the full cohort; other columns are counts. Surgical status was unavailable for one patient with malignant cytology lost to follow-up and one with nondiagnostic cytology whose death was recorded. Cytology groups refer to the selected index nodule; surgery is a patient-level outcome. Indeterminate denotes AUS (Bethesda category III).

management in one patient with indeterminate index cytology and one with nondiagnostic index cytology.

Of the three patients with malignant cytology without documented thyroid surgery, one was receiving treatment for another malignancy, one was lost to follow-up, and one had no documented explanation for non-operative management. The patient lost to follow-up was classified as having unavailable surgical status. The second unavailable status occurred in a patient with nondiagnostic cytology whose death was recorded. One malignant cytology result had an unresolved primary thyroid versus metastatic origin.

3.5. Nodules Outside Routine ACR TI-RADS Criteria

Twelve of 96 biopsied nodules (12.5%) fell outside routine ACR TI-RADS category-and-size criteria: two TR2 nodules and ten TR3-TR5 nodules below the applicable size thresholds. Cytology was benign in six, nondiagnostic in three, and malignant in three (Table 4).

Table 4. Biopsied nodules and routine ACR TI-RADS criteria.

ACR category	Nodules n	Routine FNA recommendation	Outside criteria, n	Cytology outside criteria B/ND/I/M
TR2	2	No routine FNA	2	2/0/0/0
TR3	14	Maximum ≥ 2.5 cm	3	3/0/0/0
TR4	50	Maximum ≥ 1.5 cm	5	1/2/0/2
TR5	30	Maximum ≥ 1.0 cm	2	0/1/0/1
Total	**96**	—	**12**	**6/3/0/3**

B, benign; ND, nondiagnostic; I, indeterminate (AUS; Bethesda category III); M, malignant. Ten TR3 - TR5 nodules were below the applicable size threshold; two additional nodules were TR2. Twelve nodules were outside routine category-and-size criteria and 84 met them. This comparison does not determine the clinical appropriateness of an individual biopsy. Sources: [2] [5].

4. Discussion

4.1. Principal Findings

In this selected sample, 26/96 index nodules had nondiagnostic cytology. Repeat cytology was available for fewer than half of the initially nondiagnostic group, and five of those 12 results were also nondiagnostic. The findings support a focused local review of specimen adequacy and the documentation needed to establish subsequent management. However, they cannot be extrapolated to estimate the current service-wide nondiagnostic rate or the proportion of patients whose diagnostic assessment was completed.

The practical contribution is the distinction between index cytology, a recorded plan, an available repeat result, and subsequent surgery. Each answers a different service question. A planned biopsy does not establish completion, and an absent procedure record does not establish absence of appropriate clinical care.

4.2. Interpreting Specimen Adequacy

The nondiagnostic proportion warrants joint radiology-pathology review, while recognizing the selection limitations. Houlton and colleagues reported 136 nondiagnostic results among 790 thyroid FNAs (17%) across an academic centre and two community hospitals [7]. Their heterogeneous historical cohort did not reliably distinguish ultrasound from palpation guidance and is contextual evidence rather than a performance target for this service.

Potential contributors include nodule composition, targeting, specimen preparation, and cytologic assessment. Nondiagnostic cytology is not, by itself, evidence of a technical error. Review of ultrasound and pathology records would help distinguish case characteristics from modifiable acquisition or processing factors. The present dataset cannot attribute nondiagnostic results to the needle gauge, number of passes, operator, or preparation method.

A meta-analysis of 17 studies reported pooled adequacy of 76% without ROSE and 92% with ROSE, with larger benefit in settings with lower baseline adequacy [3]. This supports considering a locally evaluated ROSE pathway alongside other procedural improvements.

4.3. Interpreting Subsequent Care

The difference between 17 repeat-biopsy listings and 12 available results included cancellation, a pending procedure, ultrasound reassessment without recommended aspiration, and an unavailable result. These are different clinical and administrative states. Likewise, the six records without further FNA do not establish loss to follow-up or inappropriate management.

Among the 12 available same-nodule repeat results, seven were benign and five remained nondiagnostic. The small subgroup, wide confidence intervals, and unavailable results limit inference about repeat-FNA yield across the entire initially nondiagnostic group. The later management of the five repeatedly nondiagnostic nodules was not captured. Without a verified chronology, a pending entry cannot establish the duration of a delay.

ATA guidance recommends repeat ultrasound-guided aspiration after an initial nondiagnostic result and individualized management of repeatedly nondiagnostic nodules according to sonographic and clinical risk [1]. Local documentation should identify the responsible clinician, intended next assessment, whether it occurred, and the resulting decision. An appropriate endpoint may be surveillance or surgery as well as repeat aspiration; the audit did not adjudicate these decisions.

4.4. Surgery and Biopsy Selection

Recorded surgery varied across index cytology groups, but these patient-level observations do not establish that every operation was prompted by the selected nodule. Without systematic histology and complete follow-up, the data cannot estimate diagnostic accuracy, malignancy risk, surgical appropriateness, or avoided

operations. One malignant interpretation also had unresolved primary thyroid versus metastatic origin.

Twelve biopsied nodules fell outside routine ACR category-and-size criteria, including three with malignant cytology. Because clinicians had already selected these nodules for biopsy, this subgroup cannot estimate cancer risk among all nodules below the thresholds or cancers that would be missed by applying the recommendations. Previous biopsy and the broader clinical scenario affect interpretation [5] [8]. A growth indication alone does not establish eligibility: ACR advice applies the new size to the relevant category threshold [5].

Recording the rationale for biopsy outside routine criteria would permit later adjudication of clinical exceptions. The present findings support reviewing that documentation; they neither quantify unnecessary biopsies nor demonstrate failure of ACR TI-RADS.

4.5. Comparison with Canadian Thyroid FNA Studies

Canadian studies have examined the quality of thyroid nodule investigation through multidisciplinary referral review and standardized ultrasound reporting. Baldwin *et al.* evaluated 252 referrals to a multidisciplinary pre-FNA clinic in Saskatchewan, where biopsy was not recommended for 27 referrals (10.7%) following review [9]. Their assessment also included cytology, subsequent management, and surgical pathology. This approach illustrates how review before biopsy can identify patients for whom surveillance or another management pathway may be appropriate. Our findings address a related concern after biopsy: whether an informative specimen was obtained and whether subsequent assessment was documented when the initial result was nondiagnostic.

Wang *et al.* reviewed thyroid ultrasound reporting in 138 patients and reported nondiagnostic or unsatisfactory results in 44 of 157 biopsied nodules (28.0%) [10]. Although numerically similar to the 27.1% observed in our sample, differences in patient selection, cytology definitions, and the inclusion of multiple biopsied nodules per patient limit direct comparison. This similarity does not establish an acceptable local nondiagnostic rate. Wang *et al.* also identified incomplete documentation of sonographic features and developed an electronic synoptic reporting system to standardize their recording. Their study used an earlier TI-RADS framework, which limits comparison with the ACR category-and-size criteria applied in our analysis.

These studies provide relevant approaches to referral review and ultrasound documentation. Our findings identify specimen adequacy and documentation of subsequent care as additional priorities for local evaluation. Linking the biopsy indication, cytologic result, planned management, and subsequent assessment within a consistent nodule-level record would help distinguish a documented plan from a completed procedure or a decision to pursue surveillance. The effects of introducing such documentation, together with multidisciplinary review, would require prospective evaluation.

4.6. Strengths and Limitations

Strengths include an explicit index-nodule definition, separation of initial and repeat cytology, and denominators that distinguish planned assessment from available results. However, the sample is small, retrospective, and drawn from one hospital.

The selection method limits generalizability. Although dates were randomly generated, selecting the first-listed eligible patient introduced a nonrandom component and did not constitute simple random sampling of patients. Only a patient's first FNA was eligible for selection; repeat procedures did not provide additional opportunities for inclusion. A total of 100 date-based selection draws yielded 96 unique patients, with four duplicate patient selections prompting repetition of the randomization process. Individual inclusion probabilities could not be reconstructed, precluding sampling weights. Most index procedures occurred in 2022 (84/96, 87.5%); this concentration limits applicability to more recent practice. These results should therefore be interpreted as findings in the reviewed sample rather than a representative estimate for all FNAs performed during January 2022-October 2025.

A single reviewer abstracted the records. Selecting the largest biopsied nodule limits applicability to all sampled nodules in multinodular glands. The small repeat-cytology and outside-threshold subgroups further restrict interpretation.

Nodule composition, preparation details, operator characteristics, and clinical exceptions to routine biopsy recommendations were not systematically analyzed. Consequently, the audit cannot identify independent predictors of nondiagnostic cytology, attribute its cause, quantify avoidable FNA, or infer benefit from an untested intervention.

4.7. Next Service Evaluation

A prospective consecutive audit should enroll eligible index procedures independently of subsequent care and record a unique patient-nodule identifier, Bethesda interpretation, nodule composition, acquisition and preparation details, and documented management within a defined interval. A second reviewer should verify outcome linkage and ambiguous records. The service should agree on an adequacy target and assess time to repeat sampling and to a documented management decision. Any change, including ROSE, should then be evaluated against a clearly specified baseline and follow-up period.

5. Conclusion

Nondiagnostic cytology occurred in 26/96 index nodules in this selected quality-assurance sample. Among 12 available same-nodule repeat results, seven were benign and five remained nondiagnostic. The findings support review of specimen acquisition and processing and clearer documentation of subsequent assessment. The selection method, concentration of index biopsies in 2022, and incomplete outcome ascertainment limit service-wide interpretation and preclude causal con-

clusions. A consecutive audit with standardized nodule-level records and defined follow-up would provide a stronger assessment of current performance.

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Data Availability

The patient-level data underlying this study are not publicly available because of patient confidentiality and institutional privacy requirements. Requests concerning data access may be directed to the corresponding author. Any disclosure would be subject to applicable institutional requirements and research ethics approval.

Author Contributions

Aditya Pandya: Investigation, data curation, formal analysis, and writing. Asch Murray: Supervision and writing.

Originality and Author Approval

This manuscript reports original work that has not been published previously and is not under consideration for publication elsewhere. All authors have reviewed and approved the final manuscript, agree to its submission to Open Journal of Radiology, and accept accountability for the integrity and accuracy of the work.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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