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From research question to dissertation: A practical guide to MD Radiology thesis writing in India

Dr. Nishant Mishra[1*], Dr. Rahul Tanwar[2], Dr. Suragani Priya[1], Dr. Sahil Yadav[3], Dr. Amit Kumar[4]
[1] Department of Radiodiagnosis, N.C. Medical College & Hospital, Israna, Panipat, Haryana, India
[2] Department of Radiology, Amrita Institute of Medical Sciences, Faridabad, Haryana, India
[3] Department of Radiology, Sanskaram School of Medical Sciences, Jhajjar, Haryana, India
[4] Department of Radiology, Ajay Sangaal Institute of Medical Sciences and Research, Shamli, Uttar Pradesh, India
Corresponding Author: Dr. Nishant Mishra

Abstract
Postgraduate thesis work is a critical component of specialist medical training in India, introducing residents to research methodology, critical appraisal, scientific writing and evidence-based practice. In radiology, thesis research has additional methodological demands related to imaging acquisition, reader interpretation, diagnostic accuracy, observer variability, radiation or contrast considerations, image anonymisation and selection of an appropriate reference standard. This educational review provides a practical narrative framework for planning, conducting and writing an MD Radiology thesis in India. It covers selection of a feasible research question, formulation of objectives, literature review, study design, sample-size planning, ethical considerations, imaging methodology, data collection, statistical analysis, scientific writing and conversion of the dissertation into a journal manuscript. Particular emphasis is placed on radiology-specific issues including standardisation of acquisition protocols, predefined image-interpretation criteria, blinding, reader experience, reference standards, interobserver agreement and transparent reporting of diagnostic performance. Common errors in postgraduate research and responsible use of artificial-intelligence tools are also discussed. Institutional and university regulations should always take precedence where local requirements differ.

Keywords: Radiology, thesis, dissertation, postgraduate medical education, research methodology, diagnostic accuracy, scient ific writing, India

Introduction

A postgraduate thesis should be viewed as a structured research project rather than merely a document required before the final examination. Its educational value lies in teaching the resident how to convert a clinical uncertainty into an answerable research question, critically evaluate prior evidence, select an appropriate design, collect reproducible data, analyse results and communicate findings responsibly. A logical thesis structure also makes the final writing process substantially easier [1].

Radiology research presents distinctive challenges. Imaging findings may depend on scanner technology, acquisition parameters, operator expertise, reader experience and the diagnostic threshold used by the observer. In diagnostic-accuracy studies, validity also depends heavily on patient selection, execution and interpretation of the index test, the reference standard, and participant flow [2, 4].

In India, postgraduate medical education is governed by the applicable National Medical Commission framework, while biomedical and health research involving human participants should follow institutional requirements and national ethical guidance issued by the Indian Council of Medical Research [5, 7]. Because universities and institutions may prescribe different dissertation formats and timelines, residents should verify local regulations before protocol submission and final thesis submission. The principles described in this review are intended to complement, not replace, those requirements.

Choosing an Appropriate Thesis Topic

The best thesis topic is not necessarily the most technologically advanced or unusual. It is the question that can be answered rigorously within the available time, patient volume, equipment and expertise. Before accepting a topic, the resident and guide should estimate the number of eligible cases likely to be encountered, availability of the required modality, feasibility of follow-up, access to a credible reference standard and the likelihood of completing recruitment within residency.

A rare tumour studied prospectively may sound impressive but may fail because of inadequate recruitment. Conversely, a focused question involving a common clinical problem can yield stronger data and a more publishable manuscript. A useful principle is that clinical relevance, feasibility, measurability and methodological soundness are more valuable than novelty alone.

The topic should also avoid unnecessary duplication. A structured literature search should determine what is already established and whether the proposed study addresses a genuine uncertainty, a local evidence gap, a new technique, a different population or a meaningful comparison.

Formulating the Research Question, Aim and Objectives

A broad topic must be converted into a precise primary question. For example, “role of MRI in knee trauma” is too vague. A stronger question might evaluate the diagnostic accuracy of MRI for meniscal tears in traumatic knee injury using arthroscopy as the reference standard. This identifies the population, index test, target condition and reference standard, which are central elements of diagnostic-accuracy research [2, 3].

The primary objective should determine the sample-size calculation and principal analysis. Secondary objectives should be limited, clinically relevant and prespecified.

Adding numerous objectives simply because additional variables are available increases the risk of unfocused analysis and chance findings.

Frameworks such as PICO can help structure questions when appropriate, but they should not be applied mechanically. The final objective must be clinically meaningful and measurable using data that can realistically be obtained.

Literature Review and Identification of the Research Gap

The literature review should establish what is known, what remains uncertain and why the proposed study is needed. Residents should search recognised biomedical databases and prioritise original studies, systematic reviews, consensus statements and authoritative guidelines. References should be managed systematically from the beginning.

A weak review becomes a chronological catalogue of previous papers. A stronger review synthesises evidence by themes: disease background, existing diagnostic approaches, performance of the imaging technique, methodological limitations of previous studies and the unresolved question addressed by the thesis.

The reporting guideline appropriate to the proposed study design should also be identified early. STARD is relevant to diagnostic-accuracy studies, STROBE to observational studies, CONSORT to randomised trials and PRISMA to systematic reviews [2, 8, 10]. These documents are reporting guidelines rather than substitutes for sound study design, but using them during protocol development can reduce important omissions.

Selecting the Appropriate Study Design

The design should follow the research question. Common radiology thesis designs include prospective or retrospective observational studies, cross-sectional studies, diagnostic-accuracy studies, imaging-histopathology correlation studies, comparative modality studies, quantitative imaging studies and interobserver-agreement studies.

For diagnostic-accuracy research, the index test, target condition, reference standard and study population should be explicit. STARD 2015 provides a 30-item framework for transparent reporting, while QUADAS-2 highlights key domains of bias including patient selection, index test, reference standard, and flow and timing [2, 4].

Retrospective designs can be efficient when high-quality archived data and a reliable reference standard exist, but they are vulnerable to selection bias, incomplete clinical information and heterogeneous acquisition protocols. Prospective designs offer greater control over methodology but require realistic recruitment planning.

Writing the Research Protocol

The protocol is the operational blueprint of the thesis. It should define the rationale, research question, primary and secondary objectives, study design, setting, duration, population, inclusion and exclusion criteria, sampling method, sample-size calculation, imaging protocol, image-interpretation criteria, outcomes, reference standard, statistical analysis plan and ethical considerations.

The protocol should be finalised before recruitment whenever the study design requires prospective enrolment. Major changes after data collection begins may introduce bias and can create ethical or regulatory problems. Any necessary amendment should follow the institution's prescribed process.

Residents should discuss the protocol not only with the thesis guide but also, where appropriate, with a statistician and relevant clinical collaborators before the study starts.

Sample Size Calculation and Statistical Planning

Sample size should be linked to the primary objective rather than selected arbitrarily. In diagnostic-accuracy research, sample-size requirements may depend on anticipated sensitivity or specificity, desired precision, confidence level and expected prevalence of the target condition [11]. Comparative or quantitative studies require calculations appropriate to their primary outcome and design.

The statistical plan should be defined before final analysis. Variables should first be classified as categorical or continuous, and continuous variables should be summarised using measures appropriate to their distribution. Statistical tests should be selected according to the research question, data type, distribution, independence or pairing of observations and underlying assumptions.

Radiology residents should understand the practical meaning of sensitivity, specificity, positive and negative predictive values, likelihood ratios, confidence intervals and receiver-operating-characteristic curves when these measures are relevant. Confidence intervals should accompany key estimates because they communicate precision and are often more informative than a P value alone.

Agreement and correlation are not interchangeable. When the objective is to determine whether readers or methods agree, an appropriate agreement statistic should be used. Kappa-based methods are commonly used for categorical assessments, while intraclass correlation coefficients may be appropriate for suitable continuous measurements [12, 13]. The choice of statistic, model and interpretation should be prespecified and, where needed, discussed with a statistician.

Missing data, multiple comparisons and exploratory post-hoc analyses should be handled transparently. Statistical significance should not be equated automatically with clinical importance, and analyses should not be changed simply to obtain a statistically significant result.

Ethical Approval, Informed Consent and Research Integrity

Research involving human participants requires appropriate institutional ethical review in accordance with applicable regulations and institutional policy. ICMR provides national ethical guidance for biomedical and health research involving human participants and a dedicated policy on research integrity and publication ethics [6, 7].

Radiology requires particular attention to confidentiality because images and DICOM metadata may contain patient identifiers. Images used in presentations, dissertations or publications should be appropriately anonymised. Data access should be limited to authorised personnel and stored according to institutional policy.

Ethics approval should not be treated as retrospective paperwork. Prospective research should not begin before

required approvals are in place. Consent requirements, including circumstances in which a waiver may be considered, should be determined by the Institutional Ethics Committee rather than assumed by the investigator [6].

Radiology-Specific Research Methodology

A radiology thesis must describe imaging methods sufficiently clearly for another investigator to understand and, where possible, reproduce the study. Relevant technical information may include modality, equipment, acquisition parameters, sequences, slice thickness, contrast protocol, reconstruction and post-processing. Technical description alone is insufficient; the image-interpretation process, reader characteristics, diagnostic thresholds and blinding conditions should also be prespecified [2, 4].

As an illustrative example, a thesis evaluating multiparametric breast MRI for characterising non-mass enhancement should document the scanner and coil, relevant T2-weighted, diffusion-weighted and dynamic contrast-enhanced acquisitions, contrast administration protocol, and the lexicon used to classify enhancement. The exact technical values should reflect the local validated protocol rather than being copied from another study. The methodology should also define the number and experience of readers, what information they were blinded to, the criteria used to classify lesions and the reference standard, such as histopathology when clinically appropriate.

The reference standard deserves particular scrutiny. Histopathology, surgery, endoscopy, laboratory testing, clinical follow-up or another accepted standard may be appropriate depending on the target condition. Verification should be as consistent as possible across participants. For reader studies, interobserver or intraobserver variability may itself be an important outcome, and reliability/agreement studies should be reported transparently [13].

Data Collection and Quality Control

A structured case-record form or electronic dataset should be designed before data collection. Variables should correspond directly to the objectives and planned analyses. Collecting large numbers of irrelevant variables increases workload and the risk of data-quality problems.

Each participant should be assigned a study identifier. Clinical information, imaging findings and reference-standard results should be recorded systematically. A data dictionary is particularly useful when more than one investigator enters information.

Quality checks should occur during recruitment rather than after it ends. Missing reference-standard results, inconsistent measurements and incomplete imaging sequences are easier to identify and address while the study is ongoing than months later during analysis.

Statistical Analysis and Interpretation

Statistical analysis should convert the collected data into estimates that directly answer the prespecified objectives. Descriptive statistics should precede inferential analysis. Categorical variables are commonly summarised as counts and proportions, whereas continuous variables may be presented as mean with standard deviation or median with interquartile range depending on distribution.

For diagnostic-accuracy studies, a 2 × 2 table forms the basis for sensitivity, specificity and predictive values when the index test and reference standard are dichotomous. Confidence intervals should be reported for major accuracy estimates. ROC analysis may be useful when a continuous or ordinal imaging measure is evaluated across diagnostic thresholds.

Potential confounding factors should be considered when the study question requires adjusted analysis. Multivariable modelling should be driven by the design and clinical question rather than indiscriminate testing of every available variable. Post-hoc subgroup analyses should be clearly identified as exploratory.

P values should not be interpreted in isolation. Effect size, confidence interval, clinical relevance, potential bias and consistency with existing evidence should all influence interpretation. A statistically non-significant result does not prove equivalence or absence of an effect, particularly in an underpowered study.

Writing the Results

The Results section should present findings without interpreting them. Begin with participant flow and the final analysed sample, followed by relevant demographic and clinical characteristics. Present the primary outcome first, followed by prespecified secondary analyses.

Tables should condense information rather than reproduce paragraphs of text. Figures and radiological images should have a specific educational or scientific purpose. Representative images should be high quality, appropriately anonymised and accompanied by concise legends.

Diagnostic-accuracy studies should report appropriate performance measures with confidence intervals where possible. A flow diagram can improve transparency by showing recruitment, exclusions, performance of the index test and availability of the reference standard [2, 3].

Writing the Discussion

The Discussion should explain the meaning of the findings rather than repeat the Results. A practical structure is: principal findings, comparison with previous literature, possible explanations for agreement or disagreement, clinical implications, strengths, limitations and future directions.

Differences from previous studies should not automatically be treated as errors. They may arise from differences in disease prevalence, patient selection, equipment, imaging protocol, reader expertise, diagnostic thresholds or reference standards.

Limitations should be explicit. Common limitations include small sample size, single-centre recruitment, selection bias, retrospective design, incomplete verification, heterogeneous acquisition, lack of blinding and limited assessment of observer variability. Acknowledging limitations strengthens rather than weakens a scientifically responsible thesis.

Drawing Appropriate Conclusions from Thesis Results

The conclusion should answer the primary objective directly and remain proportional to the evidence. Association should not be described as causation, and a small single-centre study should not be used to make broad claims about national practice.

A concise conclusion that states what the study demonstrated, its likely clinical relevance and the principal limitation is usually stronger than an exaggerated claim.

Common Mistakes in MD Radiology Thesis Writing

Recurring problems include selecting an overambitious topic, beginning data collection before the protocol is mature, vague objectives, arbitrary sample sizes, inconsistent imaging protocols, poorly defined diagnostic criteria, absence of a credible reference standard, inappropriate statistics, mixing results with discussion, copying text during the literature review, ignoring negative findings, inadequate anonymisation and writing most of the dissertation immediately before the submission deadline.

The most damaging error is allowing the available data to redefine the research question after the results are known. Exploratory findings can be reported honestly, but they should not be presented as if they were prespecified primary hypotheses.

Responsible Use of Artificial Intelligence in Thesis Writing

AI-assisted tools can help with language refinement, organisation, brainstorming search terms and other supportive tasks, but they do not replace scientific judgment. Current ICMJE recommendations state that AI-assisted technologies should not be listed as authors; authors remain responsible for the accuracy, integrity and originality of submitted work, and AI use should be disclosed according to the relevant journal policy [14].

Residents should never accept AI-generated references without verification against the original source. Patient-identifiable information, confidential datasets and unpublished material should not be entered into external AI systems unless institutional policy and appropriate safeguards permit it.

Human authors remain responsible for study design, analysis, interpretation, citations and the final manuscript. These principles are consistent with broader expectations of research integrity and publication ethics [7, 14].

Converting the Thesis into a Journal Article

A dissertation and a journal manuscript, serves different purposes. The dissertation is comprehensive; a journal article should be focused. After thesis completion, the resident should identify the strongest research question, shorten the literature review, retain only methodology necessary to understand and reproduce the study, present the principal results clearly and build the discussion around the central finding.

The target journal should be selected before final manuscript formatting. Its author instructions, article type, word limit, reference style, figure requirements and disclosure policies should be followed exactly. The International Journal of Radiology Research currently requests MS Word submission and lists Title, Author Names, Author Details, Abstract, Keywords, Introduction, Conclusion and References as core manuscript elements, with a maximum of 70 references [15].

A well-designed thesis is much easier to publish than a poorly designed thesis that is extensively rewritten after completion. Publication therefore begins with protocol quality, not with manuscript formatting.

Practical Timeline for an MD Radiology Thesis

A pragmatic timeline is to use the early months of residency for topic selection, literature review, protocol development, statistical planning and ethics approval; the middle period for systematic data collection with regular quality checks; and the later period for final analysis, writing, correction and submission. The exact schedule must follow the resident's university and institutional deadlines.

Residents should maintain a living reference library, updated dataset, protocol version history and list of unresolved methodological issues throughout the project. Short, regular meetings with the guide are generally more effective than attempting to solve accumulated problems immediately before submission.

Conclusion

An MD Radiology thesis should be approached as an opportunity to learn how trustworthy imaging evidence is produced. Success begins with a focused and feasible research question and depends on a predefined protocol, appropriate ethical oversight, adequate sample-size planning, standardised imaging methodology, transparent image interpretation and systematic data collection. Radiology residents must pay particular attention to acquisition protocols, reader variability, blinding, reference standards and diagnostic-performance measures. Early planning, research integrity and adherence to appropriate reporting guidelines can transform the thesis from a mandatory academic exercise into clinically meaningful and publishable research.

Table 1: Radiology-Specific Methodological Checklist

Methodological domain	Key evaluation question for residents
Equipment and hardware	Are the imaging modality, manufacturer/model and relevant technical specifications documented?
Acquisition parameters	Is the imaging protocol sufficiently detailed to be reproducible?
Contrast media	Are agent, dose/route, injection rate and timing documented when applicable?
Image interpretation	Are positive and negative diagnostic criteria predefined and referenced?
Reader characteristics	Are the number of readers and relevant experience stated?
Blinding framework	Is it clear which clinical, laboratory, imaging or reference-standard information was available to readers?
Reference standard	Is the reference standard clearly defined and applied consistently?
Observer variability	Is interobserver or intraobserver agreement assessed when relevant?
Diagnostic performance	Are accuracy measures and confidence intervals reported appropriately?
Visual evidence	Are representative images anonymised, high quality and clearly annotated?
Radiation/contrast safety	Are relevant exposure, optimisation and contrast-safety considerations addressed?
Data security	Are identifiers removed and research data stored securely according to institutional policy?

Table 2: Practical Workflow and Common Errors Matrix

Research stage	Recommended approach	Common postgraduate error
Topic selection	Choose a clinically relevant, feasible question with adequate case volume.	Selecting a rare, overambitious or impractical topic.
Literature review	Identify existing evidence and a genuine research gap.	Compiling a superficial chronological catalogue.
Objectives	Define one clear primary objective and limited measurable secondary objectives.	Multiple vague or unmeasurable objectives.
Protocol design	Predefine study design, population, imaging methods and outcomes.	Starting data collection before protocol finalisation.
Sample size	Calculate according to the primary outcome.	Arbitrary or convenience sample without justification.
Ethics and consent	Obtain required IEC approval before research begins.	Treating ethics as retrospective paperwork.
Imaging protocol	Standardise acquisition and interpretation criteria.	Changing scan or diagnostic criteria mid-study.
Reference standard	Define and consistently apply a valid standard.	Unreliable or inconsistent verification.
Data collection	Use a predefined proforma/database with quality checks.	Reconstructing missing data at the end.
Statistical analysis	Predefine analyses appropriate to objectives and data type.	Changing tests after reviewing results.
Results	Report findings objectively with concise tables/figures.	Mixing interpretation with results.
Discussion	Interpret findings, compare evidence and acknowledge limitations.	Repeating the Results section.
Conclusion	Answer the primary question proportionately.	Making claims beyond the data.
Publication	Condense the dissertation into a focused journal manuscript.	Submitting the dissertation almost unchanged.

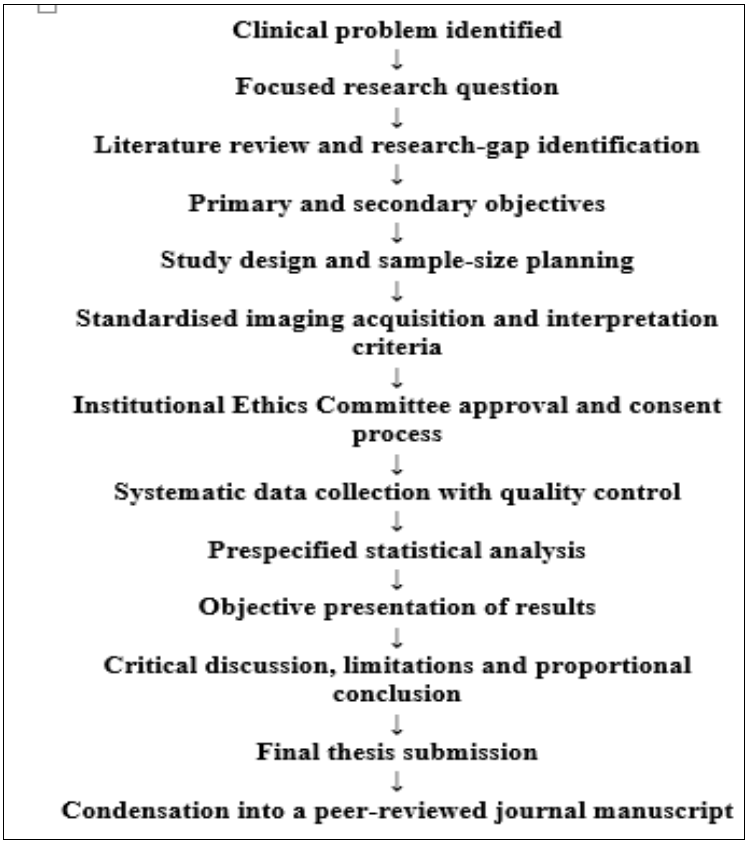

Fig 1: Suggested MD Radiology Thesis Workflow

Declarations

Conflict of Interest: The authors declare no conflict of interest.

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