International Journal of Medicine & Health Research
www.internationalmedicalpublishing.com

Research Article

Section: Respiratory Medicine

Correlation of Pulmonary Function Tests with Conventional & Caliper-Based Quantitative HRCT Analysis in Interstitial Lung Diseases

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HIGHLIGHTS

- HRCT predicts lung function.
- CALIPER quantifies fibrosis.
- Quantitative HRCT improves assessment.
- Fibrosis reflects disease severity.
- Combined imaging enhances management.

Key Words:
Interstitial Lung Disease
High-Resolution Computed Tomography (HRCT)
Pulmonary Function Test (PFT)
Lung Texture Analysis (LTA)
CALIPER

ABSTRACT

Introduction: Interstitial lung diseases (ILDs) are diffuse parenchymal lung disorders characterized by inflammation and fibrosis. HRCT and pulmonary function tests are key to disease assessment, while CALIPER-based Lung Texture Analysis provides objective quantification of disease burden. **Aim & Objective:** This study aimed to evaluate the correlation between HRCT findings and pulmonary function parameters and compare conventional radiologist-based HRCT assessment with CALIPER-derived quantitative analysis. **Materials & Methods:** This prospective, observational, cross-sectional study included 50 patients with diagnosed ILD over 24 months at a tertiary care center. All participants underwent spirometry and HRCT of the thorax. HRCT images were evaluated visually by an experienced radiologist and quantitatively using CALIPER-based LTA. Ground-glass opacity, reticulation, honeycombing, and fibrosis scores were correlated with spirometric parameters, particularly FVC% predicted, using Pearson correlation analysis. **Results:** Moderate, statistically significant positive correlations were observed between radiologist and CALIPER assessments for ground-glass opacity ($r=0.634$), reticulation ($r=0.644$), honeycombing ($r=0.414$), and fibrosis score ($r=0.430$). Fibrosis score showed a strong inverse correlation with FVC% predicted using CALIPER ($r=-0.743$, $p<0.001$) and a moderate inverse correlation using radiologist assessment ($r=-0.493$, $p<0.001$). Quantitative LTA showed good agreement with conventional visual HRCT assessment and reliably reflected functional impairment across different ILD subtypes. **Conclusion:** HRCT-derived fibrosis extent correlates significantly with pulmonary function impairment in ILD. CALIPER-based quantitative Lung Texture Analysis complements conventional HRCT interpretation by providing an objective and reproducible assessment of disease burden. Integration of quantitative imaging with spirometry may improve disease severity assessment, monitoring, and clinical decision-making in patients with ILD.

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Article History: Received 19 May 2026; Received in Revised form 06 July 2026; Accepted 13 July 2026
How To Cite: Rajeeh Shakil, Ummul Baneen, M Shameem, Saifullah Khalid, Nafees A Khan & Lubna Naseem Khan. Correlation of Pulmonary Function Tests with Conventional & Caliper-Based Quantitative HRCT Analysis in Interstitial Lung Diseases. *International Journal of Medicine & Health Research.* 2026;14(2):1-10. DOI: https://doi.org/10.71393/we8cw179

INTRODUCTION

Interstitial lung diseases (ILDs) comprise a diverse group of diffuse parenchymal lung disorders characterized by varying degrees of inflammation and fibrosis involving the pulmonary interstitium. Their global recognition has increased because of improved diagnostic imaging, greater clinical awareness, and an aging population. Progressive fibrosis results in irreversible structural lung damage, impaired gas exchange, restrictive ventilatory defects, and declining respiratory function, leading to considerable morbidity and mortality. Patients commonly present with non-specific symptoms such as progressive exertional dyspnea, persistent dry cough, fatigue, and reduced exercise tolerance, often causing delayed diagnosis. Among the various ILD subtypes, idiopathic pulmonary fibrosis (IPF) is one of the most extensively studied, while Indian registry data indicate that hypersensitivity pneumonitis and IPF account for a substantial proportion of diagnosed cases, highlighting the increasing clinical burden of these diseases [1-3].

The pathogenesis of ILDs is complex and involves interactions between genetic predisposition, environmental exposures, epithelial injury, immune dysregulation, and abnormal tissue repair. Persistent alveolar epithelial damage activates fibroblasts and myofibroblasts, promoting excessive extracellular matrix deposition and progressive fibrosis that distorts normal lung architecture. Although inflammatory mechanisms predominate in certain ILD subtypes, fibrosis is the principal determinant of disease progression, respiratory impairment, and long-term prognosis. Because clinical manifestations and radiological patterns vary considerably among ILDs, diagnosis requires a multidisciplinary approach involving pulmonologists, radiologists, pathologists, and rheumatologists. Accurate assessment of disease severity and extent is essential for diagnosis, treatment planning, prognostication, and monitoring disease progression [4-6]. High-resolution computed tomography (HRCT) is the imaging modality of choice for evaluating ILDs owing to its ability to provide detailed visualization of parenchymal abnormalities. Typical HRCT findings include ground-glass opacities, reticulation, traction bronchiectasis, architectural distortion, and honeycombing, which help classify the disease and assess severity.

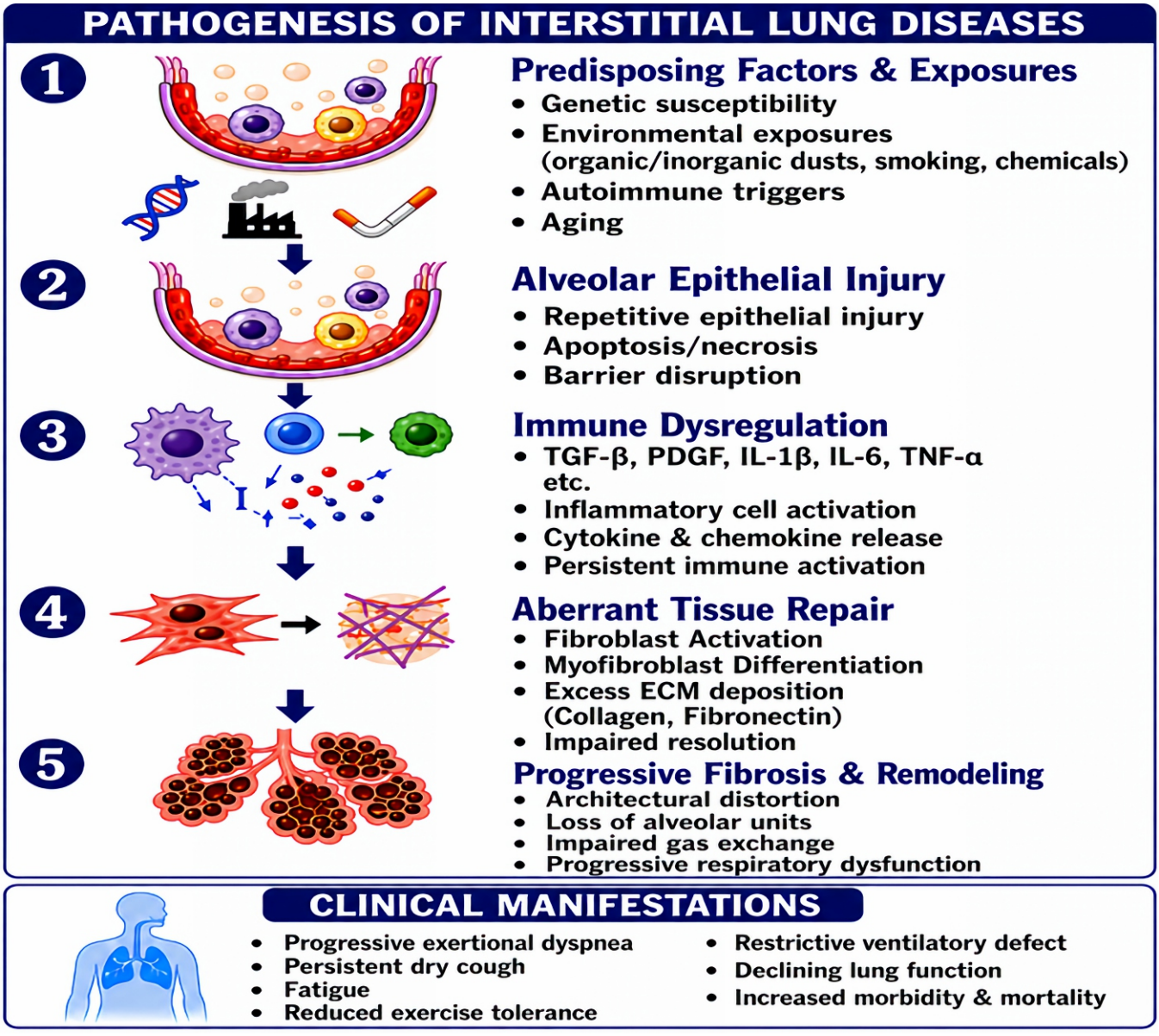


Figure 1: Schematic illustration of the pathogenesis and clinical manifestations of interstitial lung diseases (ILDs).

In patients with a definite usual interstitial pneumonia (UIP) pattern, HRCT may establish the diagnosis without the need for surgical lung biopsy. HRCT also plays a key role in disease staging, therapeutic monitoring, and follow-up. However, conventional visual interpretation relies on radiologist expertise and is subject to inter-observer variability, particularly when inflammatory and fibrotic abnormalities coexist, emphasizing the need for more objective and reproducible assessment methods [7-9].

Pulmonary function tests (PFTs), particularly spirometry, complement HRCT by providing an objective evaluation of the physiological impact of structural lung abnormalities. Reduced forced vital capacity (FVC) is a hallmark of restrictive lung disease and serves as an important indicator of disease severity and progression. Correlating structural abnormalities detected on HRCT with functional impairment measured by spirometry is clinically valuable for assessing disease burden. Shen Y, et. al; 2026, demonstrated significant inverse relationships between HRCT-derived fibrosis scores and pulmonary function parameters such as FVC, total lung capacity, and diffusing capacity for carbon monoxide, although these associations may vary depending on disease distribution, preserved lung parenchyma, coexisting emphysema, and the relative contribution of inflammatory versus fibrotic lesions [7,10-12].

Advances in artificial intelligence have introduced quantitative imaging techniques for ILD evaluation. Rating (CALIPER) platform), particularly using the computer-Aided Lung Informatics for Pathology Evaluation and Rating (CALIPER) platform, enables automated quantification of ground-glass opacities, reticulation, honeycombing, fibrosis, and other parenchymal abnormalities. Quantitative HRCT analysis reduces observer variability, provides reproducible assessment of disease burden, and has shown good correlations with pulmonary function, disease progression, and survival. However, limited evidence directly compares conventional radiologist-based HRCT assessment with CALIPER-derived quantitative analysis while correlating these findings with spirometric parameters. Therefore, the present study was undertaken to evaluate the relationship between HRCT findings and pulmonary function abnormalities in ILD by comparing conventional radiologist assessment with CALIPER-based Lung Texture Analysis, to improve disease severity assessment and support routine clinical management [13-15]. **Figure 1.** Pathogenesis and clinical manifestations of interstitial lung diseases (ILDs), illustrating the sequential progression from predisposing factors and alveolar epithelial injury through immune dysregulation, aberrant tissue repair, and progressive fibrosis leading to respiratory dysfunction.

Rationale

Visual assessment of HRCT is observer-dependent and may vary between radiologists, particularly in mixed inflammatory and fibrotic ILD. Quantitative CALIPER-based lung texture analysis offers an objective and reproducible assessment of disease extent. Comparing visual HRCT assessment with CALIPER and correlating both with spirometry may improve evaluation of disease severity in patients with ILD. To evaluate the correlation between HRCT findings and pulmonary function tests in patients with ILD, compare conventional radiologist-based HRCT assessment with CALIPER-derived quantitative lung texture analysis, and determine whether quantitative fibrosis assessment demonstrates a stronger association with FVC% predicted than visual assessment.

MATERIALS & METHODS

This prospective, observational, cross-sectional was conducted at the Department of Respiratory Medicine, Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh, Uttar Pradesh, India, for 24 months. Ethical approval has been obtained from the Ethical Approval Committee of Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh, Uttar Pradesh, India.

Study Population

The study population comprised patients attending the Respiratory Medicine Outpatient Department (OPD) or admitted to the Inpatient Department (IPD) at JNMCH with a diagnosis or clinical suspicion of Interstitial Lung Disease (ILD). Eligible patients diagnosed radiologically or clinically were enrolled after obtaining informed consent and applying the exclusion criteria. Patients who declined consent, were pregnant, or were unable to perform pulmonary function tests (PFTs) were excluded from the study.

Sample size calculation

A total of 50 patients were included. Convenient sampling was employed during the study period based on eligible patients fulfilling the inclusion criteria.

Inclusion criteria

- Age >18 years
- HRCT suggestive of ILD
- Able to perform spirometry.

Exclusion criteria

- Age <18 years
- Pregnancy
- Refusal to consent
- Inability to perform spirometry.

HRCT protocol

HRCT was performed on a 64-slice Siemens CT scanner with patients in the supine position using 0.1 mm slice thickness.

Visual Interpretation of HRCT by Radiologist

All participants underwent High-Resolution Computed Tomography (HRCT) of the thorax using a standardized acquisition protocol. HRCT images were independently assessed by an experienced radiologist for the extent of major

parenchymal abnormalities, including ground-glass opacity (GGO), reticulation, and honeycombing. Both lungs were divided into six anatomical zones (right upper, right middle, right lower, left upper, left middle, and left lower zones). The percentage extent of each abnormality was visually estimated separately for each zone. The zonal scores were summed and averaged across all six zones to derive the overall percentage extent of each abnormality for the entire lung. The calculated values were rounded to the nearest whole number for analysis. A visual fibrosis score was subsequently calculated as the sum of the overall percentage extent of reticulation and honeycombing, representing the total fibrotic involvement on HRCT.

Spirometry protocol

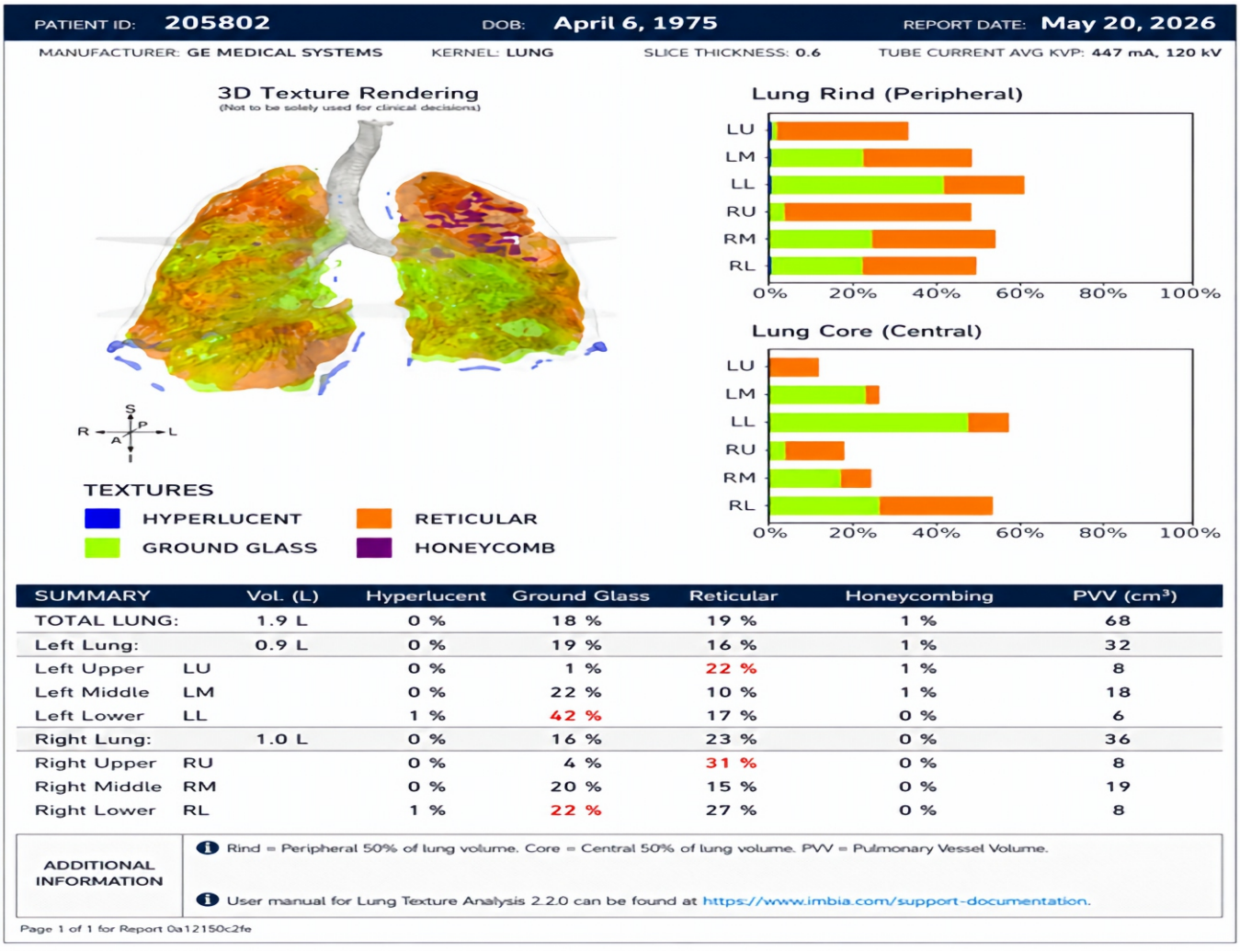
Pulmonary function testing was performed using computerized spirometry according to the American Thoracic Society/ European Respiratory Society (ATS/ERS) 2019 guidelines. Predicted spirometric values were calculated using the Knudson reference equations. Each participant performed a minimum of three acceptable forced expiratory manoeuvres, and the best of the three acceptable manoeuvres was selected for analysis. The primary spirometric parameter used for correlation with HRCT findings was Forced Vital Capacity (FVC % predicted).

CALIPER analysis

Lung Texture Analysis (LTA) was performed using the CALIPER software, which automatically segmented the lungs into anatomical regions and classified lung parenchyma into predefined texture categories. The software quantified the percentage volume of ground-glass opacity, reticulation, honeycombing, hyperlucent lung, pulmonary vessel volume (PVV), and total lung volume for the whole lung and for individual lobar regions. The software also displayed peripheral (lung rind) and central (lung core) distribution of the abnormalities. Among all parameters generated by CALIPER, ground-glass opacity, reticulation, honeycombing, fibrosis score, pulmonary vessel volume (PVV), and total lung volume were included for statistical analysis. The fibrosis score was calculated as the sum of the overall percentage extent of reticulation and honeycombing, representing the quantitative fibrotic burden **(Figure 2)**.

Study Plan

Correlation analysis was initially performed using the entire study cohort (n = 50) to evaluate the relationship between HRCT findings and pulmonary function parameters. Subsequently, patients were categorized into fibrosis-predominant and ground-



SUMMARY		Vol. (L)	Hyperlucent	Ground Glass	Reticular	Honeycombing	PVV (cm³)
TOTAL LUNG:		1.9 L	0 %	18 %	19 %	1 %	68
Left Lung:		0.9 L	0 %	19 %	16 %	1 %	32
Left Upper	LU		0 %	1 %	22 %	1 %	8
Left Middle	LM		0 %	22 %	10 %	1 %	18
Left Lower	LL		1 %	42 %	17 %	0 %	6
Right Lung:		1.0 L	0 %	16 %	23 %	0 %	36
Right Upper	RU		0 %	4 %	31 %	0 %	8
Right Middle	RM		0 %	20 %	15 %	0 %	19
Right Lower	RL		1 %	22 %	27 %	0 %	8

Figure 2: Report of LTA (CALIPER Lung Texture Analysis (LTA) output demonstrating automated lung segmentation and quantitative assessment of pulmonary parenchymal abnormalities)

glass-predominant groups based on the predominant imaging abnormality, and separate correlation analyses were performed for each subgroup.

Data Analysis

Data were analyzed using SPSS version 25.0. Qualitative variables were summarized using descriptive statistics and compared using the Pearson Chi-square test. The paired t-test was applied to evaluate differences between Lung Texture Analysis (LTA) and radiologist-based assessments, while Pearson's product-moment correlation analysis was used to determine associations among study variables. A p-value >0.05 was considered statistically non-significant, whereas p<0.05, p<0.01, and p<0.001 indicated statistical significance.

RESULTS

A total of 50 patients with interstitial lung disease (ILD) were prospectively enrolled to evaluate the correlation between pulmonary function tests (PFTs) and high-resolution computed tomography (HRCT) findings. The study population represented a wide age range, with the majority comprising middle-aged and elderly individuals; 38% were older than 60 years, 42% were between 41 and 60 years, and 20% were between 21 and 40 years, reflecting the increasing prevalence of ILDs with advancing age. Males and females were equally represented, with each accounting for 50% of the study population, indicating no significant gender predominance. Clinically, exertional dyspnea was the most common presenting symptom, observed in 88% of patients, followed by cough, while bilateral digital clubbing was present in 42%, highlighting the chronic and progressive nature of the disease. A broad spectrum of ILD subtypes was identified, with usual interstitial pneumonia (UIP) being the most common (46%), followed by hypersensitivity pneumonitis (20%), nonspecific interstitial pneumonia (14%), combined pulmonary fibrosis and emphysema (6%), connective tissue disease-associated ILD (6%), & desquamative interstitial pneumonia together with respiratory bronchiolitis-associated ILD (8%). The diverse distribution of ILD subtypes reflects the heterogeneity of diffuse parenchymal lung diseases encountered in routine clinical practice and enhances the applicability of the study findings. A statistically significant moderate positive correlation was observed between radiologist-assessed and CALIPER-derived ground-glass opacity scores ($r = 0.634$, $p < 0.001$), indicating good agreement between visual HRCT assessment and automated lung texture analysis for quantifying ground-glass opacities **(Table 1)**. A statistically significant concordance was observed between radiologist-assessed and CALIPER-derived reticulation scores ($r = 0.644$, $p < 0.001$), demonstrating good agreement between visual HRCT assessment and automated lung texture analysis in quantifying fibrotic reticular abnormalities **(Table 2)**. A statistically significant positive association was observed between radiologist-assessed and CALIPER-derived honey combing scores ($r = 0.414$, $p = 0.003$), indicating reasonable agreement between visual HRCT assessment and automated lung texture analysis. Overall, CALIPER demonstrated significant positive correlations with radiologist assessments for ground-glass opacity, reticulation, and honeycombing, supporting its value as an objective quantitative tool that complements conventional HRCT evaluation in patients with interstitial lung disease **(Table 3)**. A statistically significant good agreement was observed between radiologist-derived and CALIPER-derived fibrosis scores ($r = 0.430$, $p = 0.003$), indicating reasonable agreement between visual HRCT assessment and automated lung texture analysis in quantifying overall fibrotic lung involvement. These findings support the reliability of CALIPER as an objective tool for fibrosis assessment in patients with interstitial lung disease **(Table 4)**.

Among all 50 patients, both CALIPER-derived and radiologist-derived fibrosis scores showed statistically significant negative correlations with FVC % predicted. The CALIPER-derived fibrosis score demonstrated a strong inverse correlation ($r = –0.743$, $p < 0.001$), whereas the radiologist-derived fibrosis score showed a moderate inverse correlation ($r = –0.493$, $p < 0.001$), indicating that increasing fibrosis burden is associated with worsening restrictive pulmonary function, with CALIPER exhibiting a stronger relationship with functional impairment **(Table 5)**.Ground-glass opacity showed no significant corr elation with FVC % predicted in the overall study population. CALIPER-derived ground-glass scores demonstrated a weak positive correlation ($r = 0.194$, $p = 0.176$), while radiologist-assessed scores showed an even weaker, non-significant correlation ($r = 0.109$, $p = 0.450$). These findings indicate that, unlike fibrosis burden, the extent of ground-glass opacity alone is not a reliable indicator of pulmonary function impairment in a heterogeneous cohort of patients with interstitial lung disease **(Table 6)**. Among the 38 patients with fibrosis-predominant interstitial lung disease, both CALIPER-derived and radiologist-derived fibrosis scores demonstrated statistically significant negative correlations with FVC % predicted. The CALIPER-derived fibrosis score showed a strong inverse correlation ($r = –0.724$, $p < 0.001$), while the radiologist-derived fibrosis score showed a moderate inverse correlation ($r = –0.540$, $p < 0.001$), indicating that increasing fibrotic burden is associated with greater pulmonary function impairment. The stronger correlation observed with CALIPER suggests that quantitative lung texture analysis may provide a more sensitive assessment of fibrosis severity than conventional visual HRCT evaluation **(Table 7)**. Among the 12 patients with ground-glass opacity-predominant interstitial lung disease, CALIPER-derived ground glass scores showed a statistically significant correspondence with FVC % predicted ($r = 0.595$, $p < 0.05$), whereas radiologist-assessed ground-glass scores demonstrated a weaker, non-significant correlation ($r = 0.383$, $p = 0.219$). These findings suggest that quantitative lung texture analysis may be more sensitive than conventional visual HRCT assessment in detecting ground-glass abnormalities associated with pulmonary function in predominantly non-fibrotic ILD **(Table 8)**.

Table 1: Correlation between radiologist and LTA for ground glass opacity

Pearson Correlation		Total Lung GG (Radiologist)
Total Lung GG (LTA)	Correlation Coefficient	0.634**
	Sig. (2-tailed)	0.001
**Correlation is significant at the 0.01 level (2-tailed)		

Table 2: Correlation between radiologist and LTA for Reticulation

Pearson Correlation		Total Lung Reticulation (Radiologist)
Total Lung Reticulation (LTA)	Correlation Coefficient	0.644**
	Sig. (2-tailed)	0.001
**Correlation is significant at the 0.01 level (2 -tailed)		

Table 3: Correlation between radiologist and LTA for honeycombing

Pearson Correlation		Total Lung Honeycombing (Radiologist)
Total Lung Honeycombing (LTA)	Correlation Coefficient	0.414**
	Sig. (2-tailed)	0.003
**Correlation is significant at the 0.01 level (2 -tailed)		

Table 4: Correlation between radiologist and LTA for fibrosis score

Pearson Correlation		Fibrosis Score (Radiologist)
Fibrosis Score (LTA)	Correlation Coefficient	0.430**
	Sig. (2-tailed)	0.002
**Correlation is significant at the 0.01 level (2 -tailed)		

Table 5: Correlation of radiologist and LTA assessed fibrosis score with FVC % predicted

Pearson Correlation		Fibrosis Score	Fibrosis Score (Radiologist)
FVC (%pred)	Correlation Coefficient	-0.743**	-0.493**
	Sig. (2-tailed)	0.001	0.001
**Correlation is significant at the 0.01 level (2 -tailed)			

Table 6: Correlation of radiologist and LTA assessed ground glass score with FVC % predicted

Pearson Correlation		Total Lung GG (LTA)	Total Lung GG (Radiologist)
FVC (%pred)	Correlation Coefficient	0.194**	0.109
	Sig. (2-tailed)	0.176	0.450
**Correlation is significant at the 0.01 level (2 -tailed)			

Table 7: Correlation of radiologist and LTA assessed fibrosis score in fibrosis predominant patients with FVC % predicted

Pearson Correlation		LTA Fibrotic	Radiologist Fibrotic
FVC (% pred)	Correlation Coefficient	-0.724**	-0.540**
Fibrotic	Sig. (2-tailed)	0.001	0.001
**Correlation is significant at the 0.01 level (2 -tailed)			

Table 8: Correlation of radiologist and LTA assessed ground glass in non-fibrotic group patients with FVC % predicted

Pearson Correlation		Non-Fibrotic GG (LTA)	Non- Fibrotic GG (Radiologist)
FVC	Correlation Coefficient	0.595**	0.383
	Sig. (2-tailed)	0.041	0.219
**Correlation is significant at the 0.01 level (2 -tailed)			

DISCUSSION

The present study was undertaken to evaluate the correlation between pulmonary function tests (PFTs) and high-resolution computed tomography (HRCT) findings in patients with interstitial lung disease (ILD). Interstitial lung diseases are a heterogeneous group of diffuse parenchymal lung disorders characterized by varying degrees of inflammation and fibrosis, making diagnosis and disease monitoring challenging. Accurate assessment of disease severity is essential for appropriate clinical management, prognostication, and evaluation of treatment response. By examining the association between functional impairment and radiological abnormalities, the present study aimed to improve understanding of the structure–function relationship in ILD and determine the clinical utility of HRCT-derived fibrosis assessment. The study included 50 patients diagnosed with ILD at a tertiary care center, providing an opportunity to evaluate the relationship between imaging findings and pulmonary function in a representative clinical population [14-16]. The demographic profile of the study population reflected the epidemiological characteristics of ILD reported in previous literature. Most patients belonged to the middle-aged and elderly age groups, with 38% of patients older than 60 years and 42% between 41 and 60 years of age. Vasakova M, et. al; 2019, reported that the prevalence of ILD in India increases with advancing age and reaches its peak during the sixth and seventh decades of life. Aging is recognized as a major risk factor for fibrotic interstitial lung diseases, particularly idiopathic pulmonary fibrosis (IPF), owing to mechanisms such as cellular senescence, telomere shortening, mitochondrial dysfunction, impaired tissue repair, and cumulative exposure to environmental and occupational risk factors. Delayed diagnosis may also contribute to the predominance of older patients, as early symptoms including exertional dyspnea and chronic cough are often attributed to aging or coexisting cardiopulmonary disorders [17,18].

The study demonstrated an equal distribution of male and female patients, indicating that both sexes were similarly represented. Exertional dyspnea was the most frequent presenting complaint, followed by chronic cough, which is consistent with the classical clinical manifestations described in previous studies of ILD. A considerable proportion of patients also exhibited bilateral digital clubbing, reflecting the chronic and progressive nature of diffuse parenchymal lung disease. The inclusion of patients with different ILD phenotypes further strengthened the clinical relevance of the study. Usual interstitial pneumonia (UIP) was the predominant subtype, accounting for 46% of cases, followed by hypersensitivity pneumonitis, nonspecific interstitial pneumonia, combined pulmonary fibrosis with emphysema, and smoking-related ILDs. This distribution closely resembles that reported in international ATS/ERS guidelines and Indian registries, thereby improving the applicability of the findings to routine clinical practice [19-22]. The principal finding of the present study was the significant inverse correlation between HRCT-derived fibrosis burden and forced vital capacity (FVC) percent predicted. Both radiologist-based fibrosis scores and quantitative Lung Texture Analysis (LTA)-derived fibrosis scores demonstrated significant negative correlations with pulmonary function, indicating that greater fibrotic involvement was associated with more severe restrictive ventilatory impairment. These observations are biologically plausible because progressive fibrosis causes irreversible destruction of alveolar architecture, increased lung stiffness, reduced compliance, and diminished lung volumes. Consequently, patients with extensive fibrosis on HRCT are expected to demonstrate lower FVC values. Similar associations between radiological fibrosis and pulmonary function have been consistently reported in previous studies, confirming that fibrosis burden serves as a reliable imaging marker of disease severity and physiological impairment in ILD [12,23-26]. An important observation of the present study was that fibrosis exhibited a considerably stronger association with pulmonary function impairment than ground-glass opacity. While fibrosis scores correlated significantly with FVC, ground-glass opacities demonstrated relatively weak and statistically non-significant correlations when the overall study population was analyzed. This finding can be explained by the heterogeneous pathological basis of ground-glass attenuation, which may represent inflammation, edema, cellular infiltration, early fibrosis, or mixed pathological processes. Unlike established fibrosis, these abnormalities do not consistently produce substantial restrictive impairment, particularly when multiple ILD subtypes are evaluated together. Subgroup analysis further reinforced these observations by demonstrating a stronger negative correlation between fibrosis scores and FVC among patients with fibrosis-predominant disease. Collectively, these findings emphasized that HRCT-derived fibrosis burden is a more reliable indicator of functional impairment than ground-glass opacity and support the complementary use of HRCT and pulmonary function testing for comprehensive assessment of disease severity, monitoring of progression, and clinical management in patients with interstitial lung disease [23,27-30].

CONCLUSION

The present study evaluated the relationship between HRCT findings and pulmonary function in 50 patients with interstitial lung disease. HRCT-derived fibrosis burden showed significant negative correlations with FVC, indicating that greater fibrosis is associated with worse functional impairment, while ground-glass opacity showed weaker associations. Quantitative HRCT analysis correlated well with radiologist assessment, supporting its clinical utility. Although limited by its single-center, cross-sectional design and small sample size, the study highlights HRCT-derived fibrosis as a potentially reliable marker of disease severity and supports integrating quantitative imaging with pulmonary function testing for comprehensive ILD assessment.

LIMITATIONS & FUTURE PERSPECTIVES

The study was limited by its single-centre design, relatively small sample size, and short duration, which may restrict generalizability. Future research could focus on multicenter studies with larger cohorts to validate findings, evaluate long-term outcomes, and explore innovative diagnostic and management strategies for appendicular perforation, improving patient prognosis and reducing complications.

CLINICAL SIGNIFICANCE

The clinical significance of this study lies in its potential to bridge the gap between research findings and practical healthcare applications. It emphasizes the importance of translating scientific observations into meaningful improvements in patient care, diagnosis, and treatment outcomes. By highlighting realworld relevance, the study contributes to evidence-based medical practice and supports informed clinical decision-making. Ultimately, the findings aim to enhance patient quality of life, optimize therapeutic strategies, and promote better disease management in clinical settings.

ABBREVIATIONS

AT: Anterior tucking
HRCT: High-Resolution Computed Tomography
ILD: Interstitial Lung Disease
PFT: Pulmonary Function Test

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AUTHOR CONTRIBUTIONS

All authors significantly contributed to the study conception and design, data acquisition, or data analysis and interpretation. They participated in drafting the manuscript or critically revising it for important intellectual content, consented to its submission to the current journal, provided final approval for the version to be published, and accepted responsibility for all aspects of the work. Additionally, all authors meet the authorship criteria outlined by the International Committee of Medical Journal Editors (ICMJE) guidelines.

ACKNOWLEDGEMENT

The authors sincerely acknowledge the seniors of the Department of Respiratory Medicine, Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh, India. We are grateful to our college for providing the necessary resources to carry out this work. We also extend our heartfelt thanks to ourcolleagues and technical staff for their valuable assistance during the study.

CONFLICT OF INTEREST

Authors declared that there is no conflict of interest.

FUNDING

None

ETHICAL APPROVAL & CONSENT TO PARTICIPATE

All necessary consent & approval was obtained by authors.

CONSENT FOR PUBLICATION

All necessary consent for publication was obtained by authors.

DATA AVAILABILITY

All data generated and analyzed are included within this research article. The datasets utilized and/or analyzed in this study can be obtained from the corresponding author upon a reasonable request.

USE OF ARTIFICIAL INTELLIGENCE (AI) & LARGE LANGUAGE MODEL (LLM)

The authors confirm that no AI & LLM tools were used in the writing or editing of the manuscript, and no images were altered or manipulated using AI & LLM.

AUTHOR'S NOTE

This article serves as an important educational tool for the scientific community, offering insights that may inspire future research directions. However, they should not be relied upon independently when making treatment decisions or developing public health policies.

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