

**Occupational Lung Diseases
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Lee WJ, Choi BS, Kim SJ, et al. Development of standard digital images for pneumoconiosis. <i>J Korean Med Sci.</i> 2011;26(11):1403-1408.	Review/Other-Dx	531 retired male workers	The authors developed the standard digital images to be used for classifying pneumoconiosis findings on CXR.	After consensus reading on 349 digital images matched with the first selected analog images, 120 digital images were selected as the standard digital images that considered the distribution of pneumoconiosis findings. Images with profusion category 0/1, 1, 2, and 3 were 12, 50, 40, and 15, respectively, and a large opacity were in 43 images (A = 20, B = 22, C = 1). Among pleural abnormality, costophrenic angle obliteration, pleural plaque and thickening were in 11 (9.2%), 31 (25.8%), and 9 (7.5%) images, respectively. 21/29 symbols were present except cp, ef, ho, id, me, pa, ra, and rp. A set of 120 standard digital images had more various pneumoconiosis findings than International Labour Office (ILO) standard analog radiographs that were developed from adequate methods. It can be used as digital reference images for the recognition and classification of pneumoconiosis.	4
2. International Labour Office. <i>Guidelines for the use of the ILO international classification of radiographs of pneumoconioses.</i> Revised edition 2011. ed. Geneva: International Labour Office; 2011.	Review/Other-Dx	N/A	Guidelines for the use of ILO international classification of radiographs of pneumoconioses.	N/A	4

**Occupational Lung Diseases
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
3. Sun J, Weng D, Jin C, et al. The value of high resolution computed tomography in the diagnostics of small opacities and complications of silicosis in mine machinery manufacturing workers, compared to radiography. <i>J Occup Health.</i> 2008;50(5):400-405.	Experimental-Dx	30 nonsilicosis and 30 0+ period silicosis subjects were matched with 30 I period silicosis subjects	To assess the value and usefulness of HRCT in the diagnostics of small opacities and complications of silicosis in mine machinery manufacturing workers compared to conventional radiograms.	For the HRCT examination, the GE Somatom plus apparatus was used. 8, 5 and 6 subjects were respectively diagnosed as 0+, I or I+ period silicosis based on HRCT among 90 subjects whose original diagnoses were nonsilicosis, 0+ or I period silicosis based on radiography. The numbers of small opacities in HRCT scans were significantly higher than those seen in radiography in all lung zones ($P<0.01$). HRCT was more sensitive than radiography in detecting small opacities of mid-out zones of the lung, but no statistical significance was found between the 2 methods in the detection of small opacities of lower zones of the lung. A statistically significant increase in the detectability of bulla, emphysema, pleural, mediastinal and hilar changes was observed ($P<0.05$). HRCT might be more sensitive than radiography in detecting lung parenchymal changes suggestive of silicosis.	1
4. Ooi GC, Tsang KW, Cheung TF, et al. Silicosis in 76 men: qualitative and quantitative CT evaluation--clinical-radiologic correlation study. <i>Radiology.</i> 2003;228(3):816-825.	Observational-Dx	76 men	To use qualitative and quantitative CT to test the hypothesis that impaired lung function with silicosis is due to PMF and associated emphysema.	Nodular profusion at CXR correlated ($r >0.50$) with all CT parameters of nodularity. CT PMF had the highest correlation with emphysema ($r = 0.58, P<0.001$). Nodular profusion at CXR and all CT parameters were inversely related to lung function. At multiple regression analysis, PMF and emphysema index (both at CT) were significant determinants of forced expiratory volume in 1 second ($P=0.006$ and 0.03 , respectively) and forced expiratory volume in 1 second to FVC ratio ($P=0.007$ and 0.02 , respectively). Mean lung attenuation remained related to FVC ($P=0.03$), diffusing capacity of lung for carbon monoxide ($P=0.04$), and Borg scale grade ($P=0.01$). Cigarette consumption and silica exposure duration had no independent effects on lung function.	2

**Occupational Lung Diseases
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
5. Lopes AJ, Mogami R, Capone D, Tessarollo B, de Melo PL, Jansen JM. High-resolution computed tomography in silicosis: correlation with chest radiography and pulmonary function tests. <i>J Bras Pneumol.</i> 2008;34(5):264-272.	Review/Other-Dx	44 nonsmoking patients	To correlate tomographic findings with pulmonary function findings, as well as to compare CXR findings with HRCT findings, in patients with silicosis.	Of the 44 patients studied, 41 were male. The mean age was 48.4 years. There were 4 patients who were classified as category 0 based on CXR findings and as category 1 based on HRCT findings. Using HRCT scans, we identified PMF in 33 patients, compared with only 23 patients when CXRs were used. Opacity score was found to correlate most closely with airflow, diffusing capacity of the lung for carbon monoxide and compliance. Emphysema score correlated inversely with volume, diffusing capacity of the lung for carbon monoxide and airflow. In this sample of patients presenting a predominance of large opacities (75% of the individuals), the deterioration of pulmonary function was associated with the extent of structural changes.	4
6. Antao VC, Pinheiro GA, Terra-Filho M, Kavakama J, Muller NL. High-resolution CT in silicosis: correlation with radiographic findings and functional impairment. <i>J Comput Assist Tomogr.</i> 2005;29(3):350-356.	Observational-Dx	41 stone carvers; 9 controls	To assess HRCT findings in silicosis and to better define the role of HRCT in early detection of parenchymal abnormalities in silica-exposed workers.	The most common HRCT findings were branching centrilobular structures, seen in 28/41 workers (68.3%). Nodules consistent with silicosis were detected in 53.7% workers on CXR and in 56.1% workers on HRCT. Inter-reader agreement for diagnosis of silicosis was better on HRCT (k = 0.84) than on CXR (k = 0.54). Small opacity profusion on HRCT correlated inversely with total lung capacity and FVC%.	2

**Occupational Lung Diseases
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
7. Arakawa H, Gevenois PA, Saito Y, et al. Silicosis: expiratory thin-section CT assessment of airway obstruction. <i>Radiology</i> . 2005;236(3):1059-1066.	Observational-Dx	37 men and 10 healthy controls	To prospectively evaluate if findings on paired inspiratory and expiratory thin-section CT scans in patients with silicosis correlate with pulmonary function test results.	After exclusion of 3 patients with inadequate image quality, 34 patients (mean age, 70 years; range, 53–88 years) were enrolled in the study group. Spirometric values did not differ significantly between patients with simple (n = 20) and patients with complicated (n = 14) silicosis but were significantly lower in patients than in control subjects. CT findings included air trapping (n = 33), emphysema (n = 26), nodules (n = 32), bronchiectasis (n = 22), large opacity (n = 19), and reticulation (n = 5). The extent of both air trapping and emphysema correlated negatively with spirometric values; the air trapping score showed the strongest correlation (ratio of forced expiratory volume in 1 second to FVC: rho = -0.632, P<0.001; forced expiratory flow at 50% of the FVC: rho = -0.576, P=0.001). Silicotic nodule, large opacity, and bronchiectasis scores did not correlate with obstructive functional impairments.	1
8. Savranlar A, Altin R, Mahmutyazicioglu K, et al. Comparison of chest radiography and high-resolution computed tomography findings in early and low-grade coal worker's pneumoconiosis. <i>Eur J Radiol</i> . 2004;51(2):175-180.	Observational-Dx	67 coal workers	To present and compare CXR and HRCT findings in coal workers with and without early and low-grade CWP.	Discordance between CXR and HRCT was high. Discordance rate was found higher in the early pneumoconiosis cases with negative CXR than low-grade pneumoconiosis (60%, 36% and 8%, respectively). When coal miners with normal CXR were evaluated by HRCT, 6/10 cases were diagnosed as positive. In low-grade pneumoconiosis group, the number of patients with positive CXR but negative HRCT were low in comparison to patients with CXR negative and early pneumoconiosis findings. Most of the CXR category 0 patients (10/16) were diagnosed as category 1 by HRCT. 11 cases diagnosed as CXR category 1 were diagnosed as category 0 (7/11) and category 2 (4/11) by HRCT. In CXR category 2 (8 cases), there were 4 cases diagnosed as category 1 by HRCT.	3

**Occupational Lung Diseases
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
9. Hekimoglu K, Sancak T, Tor M, Besir H, Kalaycioglu B, Gundogdu S. Fast MRI evaluation of pulmonary progressive massive fibrosis with VIBE and HASTE sequences: comparison with CT. <i>Diagn Interv Radiol.</i> 2010;16(1):30-37.	Observational-Dx	22 PMF lesions from 20 coal workers	To evaluate the diagnostic utility of volumetric interpolated breath-hold examination and half-Fourier-acquisition single-shot turbo spin-echo fast MRI sequences in the evaluation of pulmonary PMF in comparison with CT imaging.	There was almost perfect agreement among radiologists for lesion detection with kappa analysis. There was significant agreement between 3 MRI study groups and gold standard CT images. The authors found the best agreement values with contrast-enhanced volumetric interpolated breath-hold examination images for lesion detection and image quality in comparison with CT imaging. Presence of artifact was also lowest with this protocol.	1
10. Reichert M, Bensadoun ES. PET imaging in patients with coal workers pneumoconiosis and suspected malignancy. <i>J Thorac Oncol.</i> 2009;4(5):649-651.	Review/Other-Dx	6 cases	A report on cases of CWP and suspected malignancy to determine PET appearance of CWP and its utility for diagnosing lung malignancy.	On PET imaging 18/19 nodules were hypermetabolic and 5/6 patients had at least one nodule that was PET positive. Based on pathologic data and clinical follow-up, none of the 6 patients had any evidence of malignancy. In this series, PET imaging was often positive in patients with CWP; however, all were false positives with SUV measurements in the range that are typically seen with malignant nodules. Due to its high rate of false positives, PET imaging seems to be of limited utility in diagnosing malignancy in patients with underlying CWP.	4
11. Spyrtos D, Chloros D, Haidich B, Dagdilelis L, Markou S, Sichletidis L. Chest imaging and lung function impairment after long-term occupational exposure to low concentrations of chrysotile. <i>Arch Environ Occup Health.</i> 2012;67(2):84-90.	Observational-Dx	266 employees	To investigate radiographic findings in relation to lung function after occupational exposure to permissible levels of relatively pure chrysotile (0.5%–3% amphiboles).	Sensitivity of CXR was 43% compared to HRCT. Abnormal HRCT findings were found in 75 subjects (67%) and were related to age, occupational exposure duration, and spirometric data. The presence of parenchymal or visceral pleural lesions (exclusively or as the predominant abnormality) was being accompanied by lower total lung capacity and diffusion capacity. HRCT was much more sensitive than CXR for occupational chrysotile exposure. Lung function impairment was related with parenchymal but not with pleural HRCT abnormalities.	3

**Occupational Lung Diseases
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
12. Vierikko T, Jarvenpaa R, Autti T, et al. Chest CT screening of asbestos-exposed workers: lung lesions and incidental findings. <i>Eur Respir J.</i> 2007;29(1):78-84.	Observational-Dx	633 workers	To determine the feasibility of chest CT in screening for lung cancer among asbestos-exposed workers.	Noncalcified lung nodules were detected in 86 workers. Five histologically confirmed lung cancers were found. Only 1/5 cancers was also detected by plain CXR and 3 were from the group of patients with a pre-estimated lower cancer probability. Two lung cancers were stage Ia and were radically operated. In total, 277 individuals presented 343 incidental findings of which 46 required further examination. Four of these were regarded as clinically important. CT and HRCT proved to be superior to plain radiography in detecting lung cancer in asbestos-exposed workers with many confounding chest findings. The numerous incidental findings are a major concern for future screenings, which should be considered for asbestos-exposed ex-smokers and current smokers.	2
13. Das M, Muhlenbruch G, Mahnken AH, et al. Asbestos Surveillance Program Aachen (ASPA): initial results from baseline screening for lung cancer in asbestos-exposed high-risk individuals using low-dose multidetector-row CT. <i>Eur Radiol.</i> 2007;17(5):1193-1199.	Review/Other-Dx	187 individuals	To assess the prevalence of lung cancer in a high-risk asbestos-exposed cohort using low-dose multidetector CT.	One strongly suspicious mass and 8 cases of histologically proven lung cancer were found plus 491 additional pulmonary nodules (average volume: 40.72 mL, average diameter 4.62 mm). Asbestos-related changes (pleural plaques, fibrosis) were visible in 80 individuals. Lung cancer screening in this high-risk cohort showed a prevalence of lung cancer of 4.28% (8/187) at baseline screening with an additional large number of indeterminate pulmonary nodules. Low-dose multidetector CT proved to be feasible in this highly selected population.	4

**Occupational Lung Diseases
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
14. Silva CI, Muller NL, Neder JA, et al. Asbestos-related disease: progression of parenchymal abnormalities on high-resolution CT. <i>J Thorac Imaging.</i> 2008;23(4):251-257.	Review/Other-Dx	52 male asbestos workers	To evaluate the changes over time in the pattern and extent of parenchymal abnormalities in asbestos-exposed workers after cessation of exposure and to compare 3 proposed semiquantitative methods with a careful side-by-side comparison of the initial and the follow-up CT images.	There was no difference in the prevalence of the 2 most common parenchymal abnormalities (centrilobular small dotlike or branching opacities and interstitial lines) between the initial and follow-up CT scans. Honeycombing (20%) and traction bronchiectasis and bronchiolectasis (50%) were seen more commonly on the follow-up CT than on the initial examination (10% and 33%, respectively) ($P=0.01$). Increased extent of parenchymal abnormalities was evident on side-by-side comparison in 42 (81%) patients but resulted in an increase in score in at least 1 semiquantitative system in only 16 (31%) patients (all $P>0.01$, signed test).	4
15. Muravov OI, Kaye WE, Lewin M, et al. The usefulness of computed tomography in detecting asbestos-related pleural abnormalities in people who had indeterminate chest radiographs: the Libby, MT, experience. <i>Int J Hyg Environ Health.</i> 2005;208(1-2):87-99.	Observational-Dx	353 people	To determine whether HRCT is useful to screen for pulmonary abnormalities in people exposed to vermiculite containing asbestos.	Participants' 2000 medical testing results indicated only 3 of the 3 B-reader CXR reviewers had reported a pleural abnormality (indeterminate CXR). 3 expert CT scan evaluators reviewed the HRCT scans and identified pleural abnormalities in 98 (27.8%) of the 353 participants whose previous CXRs were classified indeterminate. Of these 98 people, 69 (70.4%) were either former vermiculite mine/mill workers or household contacts, and 40 (40.8%) showed pleural calcification on HRCT. 30/40 people with pleural calcification reported having no occupational exposure to either Libby vermiculite or asbestos.	2

**Occupational Lung Diseases
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
16. Elshazley M, Shibata E, Hisanaga N, et al. Pleural plaque profiles on the chest radiographs and CT scans of asbestos-exposed Japanese construction workers. <i>Ind Health</i> . 2011;49(5):626-633.	Observational-Dx	140 Japanese asbestos-exposed construction workers	To improve the screening efficiency of CXR in identifying pleural plaques by proposing a plaque morphology-based classification.	The percentages of confirmed pleural plaques on CT scans by type (number of confirmed pleural plaque on CT/number of observed on CXR) were 93% (40/43) for straight, 89% (56/63) for diamond, 88% (7/8) for double, 83% (19/23) for tapered medially, 80% (20/25) for parallel, 77% (23/30) for crescent, 79% (11/14) for tenting, 72% (18/25) for tapered-laterally (long type), and 0% (0/9) for tapered-laterally (short type). When added to the ILO classification, morphology-based classification of CXR pleural plaque findings makes its detection easier and hence CXR continues to be a suitable tool for screening asbestos-related pleural plaques based on its simplicity, low radiation exposure, wide availability and cost-effectiveness.	2
17. Weber MA, Bock M, Plathow C, et al. Asbestos-related pleural disease: value of dedicated magnetic resonance imaging techniques. <i>Invest Radiol</i> . 2004;39(9):554-564.	Observational-Dx	21 patients	To compare respiratory-gated high-spatial resolution MRI and radial MRI with ultra-short echo times with CT in the diagnosis of asbestos-related pleural disease.	The MRI protocol allowed for differentiation between normal pleura and pleura with plaques. Interobserver agreement was comparable for MRI and CT in detecting pleural plaques (median kappa = 0.72 for MRI and 0.73 for CT) and significantly higher with CT than with MRI for detection of plaque calcification (median kappa 0.86 for CT and 0.72 for MRI; $P=0.03$). Median sensitivity of MRI was 88% for detection of plaque calcification compared with CT. For assessment of pleural thickening, pleural effusion, and extrapleural fat, interobserver agreement with MRI was significantly higher than with CT (median kappa 0.71 and 0.23 for pleural thickening, 0.87 and 0.62 for pleural effusion, and 0.7 and 0.56 for extrapleural fat, respectively; $P<0.05$). For detection of mesothelioma, median kappa was 0.63 for MRI and 0.58 for CT.	2

**Occupational Lung Diseases
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
18. Gill RR, Umeoka S, Mamata H, et al. Diffusion-weighted MRI of malignant pleural mesothelioma: preliminary assessment of apparent diffusion coefficient in histologic subtypes. <i>AJR Am J Roentgenol.</i> 2010;195(2):W125-130.	Observational-Dx	62 patients	To prospectively assess, in the evaluation of patients with suspected malignant pleural mesothelioma, ADC values derived from diffusion-weighted images obtained with a free-breathing single-shot spin-echo echo-planar imaging sequence and to correlate the ADC values with the 3 histologic subtypes of malignant pleural mesothelioma.	57 patients had malignant pleural mesothelioma. 40 of the tumors were epithelioid, 11 were biphasic, and 6 were sarcomatoid. The other 5 patients had pleural thickening (2 patients), metastatic adenocarcinoma (1 patient), chronic inflammation (1 patient), and malignant lymphoma (1 patient). Because of image distortion, the diffusion-weighted images and ADC maps were not satisfactory for assessment in 7 cases. The ADC values of malignant pleural mesothelioma were $1.31 \pm 0.15 \times 10^{-3} \text{ mm}^2/\text{s}$ for the epithelioid, $1.01 \pm 0.11 \times 10^{-3} \text{ mm}^2/\text{s}$ for the biphasic, and $0.99 \pm 0.07 \times 10^{-3} \text{ mm}^2/\text{s}$ for the sarcomatoid subtypes of malignant pleural mesothelioma. The ADC of the epithelioid subtype was statistically significantly higher than that of the sarcomatoid subtype ($P < 0.05$). The ADC in the 2 cases of benign plaque was $0.85 \pm 0.17 \times 10^{-3} \text{ mm}^2/\text{s}$.	3
19. Yildirim H, Metintas M, Entok E, et al. Clinical value of fluorodeoxyglucose-positron emission tomography/computed tomography in differentiation of malignant mesothelioma from asbestos-related benign pleural disease: an observational pilot study. <i>J Thorac Oncol.</i> 2009;4(12):1480-1484.	Observational-Dx	31 patients	To investigate the role of FDG-PET/CT for differentiating asbestos-related benign pleural disease from malignant mesothelioma.	FDG-PET/CT imaging correctly detected the presence of malignancies in 15/17 patients with malignant mesothelioma for sensitivity, specificity, and overall accuracy of 88.2%, 92.9%, and 90.3%, respectively. FDG-PET/CT imaging correctly identified 13/14 cases of benign pleural disease. The mean SUV values were 6.5 ± 3.4 for malignant mesothelioma cases and 0.8 ± 0.6 for benign pleural diseases ($P < 0.001$). When we compared the 2 groups of pleural disease, a cut-off value of 2.2 for SUV gave the best accuracy with 94.1%, 100%, 100%, and 93.3% for sensitivity, specificity, positive predictive value, and negative predictive value, respectively.	3

**Occupational Lung Diseases
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
20. Pilling J, Dartnell JA, Lang-Lazdunski L. Integrated positron emission tomography-computed tomography does not accurately stage intrathoracic disease of patients undergoing trimodality therapy for malignant pleural mesothelioma. <i>Thorac Cardiovasc Surg.</i> 2010;58(4):215-219.	Observational-Dx	20 patients	To determine whether integrated PET/CT improved the intrathoracic staging of patients undergoing trimodality therapy for malignant pleural mesothelioma.	PET/CT was performed a median of 119 days (range 2-229) prior to extrapleural pneumonectomy. 16 scans were performed after talc pleurodesis. 9 scans were performed following chemotherapy. PET/CT correctly identified the T stage in 3 patients, overstaged 4 and understaged 17. 6 scans failed to identify disease that later proved to be pT4. 9 patients were found to have pN2 disease; PET/CT identified N2 disease with a sensitivity of 11.1 %, specificity of 93% and accuracy of 66%. Previous talc pleurodesis did not alter the accuracy of PET/CT staging.	3

Evidence Table Key

Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
 - a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
 - b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
 - c) the study is an expert opinion or consensus document.

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

ADC = Apparent diffusion coefficient

CT = Computed tomography

CWP = Coal worker's pneumoconiosis

CXR = Chest radiograph

FDG-PET = Fluorine-18-2-fluoro-2-deoxy-D-glucose-positron emission tomography

FVC = Forced vital capacity

HRCT = High resolution computed tomography

MRI = Magnetic resonance imaging

PMF = Progressive massive fibrosis

SUV = Standardized uptake value