ANATOMY OF LUNG ARCHITECTURE

The trachea divides into two main primary bronchi that enter the lungs at the hilum. After entering the lungs, the primary bronchi courses downward, and outward, giving rise to three bronchi in the right lung and two in the left lung, each of which supplies pulmonary lobe. These lobar bronchi divide repeatedly, giving rise to smaller bronchi, whose terminal branches are called bronchioles. Each bronchiole enters a pulmonary lobule where it branches to form five to seven terminal bronchioles (Anderson & Jespersen 1980).

Each terminal bronchiole subdivides into two or more respiratory bronchioles that serve as regions of transition between the conducting and respiratory portions of the respiratory system, the walls of respiratory bronchioles are interrupted by numerous saccular alveoli, proceeding distally along the respiratory bronchioles, the number of alveolar openings into the bronchiolar wall becomes ever greater until the wall consists of nothing else and the tubes is now called alveolar ducts. The alveolar ducts open into atria that communicate with alveolar sacs (Pumph, 1964).

All the above structures are encased in strong connective tissue sheath that extends from the level of pulmonary hila into the periphery of the lung, at the level of the alveolar ducts and sacs. The connective tissue sheath has been termed the axial fiber system by Weibel (Weibel, 1963).

The peripheral fibres extend over the surface of the lung beneath the visceral pleura and penetrate inward from the pleural surface to
marginate secondary pulmonary lobules, thus forming the interlobular septa \cite{Reid, 1959}.

A fine network of septal fibers within the alveolar septa of the lung parenchyma join with the axial and peripheral fiber network to form continuous fiber skeleton of the lung \cite{Thurlbeck WM et al., 1978}.

High resolution CT (HRCT) is performed to study small airway, the key of interpretation of using spiral machine is the understanding of the anatomy of secondary pulmonary lobule \cite{Lynch, 1993}.
The term secondary pulmonary lobule refers to a unit of lung structure, that is present in the cortex which represents the outer 3-4cm of lung. It was originally described by the nineteenth century anatomists. These “lobules” measure 1-3cm in diameter and are easily visible on the surface of the lung as irregular polyhedral shape (Weibel, 1963).

![Diagram of bronchial generations](image)

**Fig (2) Bronchial generations.** The bronchi and airways from the first generation, the trachea, to the last generation, the alveolar sacs, are represented. Bronchi which contain cartilage within their walls measure between 10 and 3mm in diameter and extend to the fourth generation, i.e., the subsegmental branches. They are easily visible by HRCT.Bronchioles with contain no cartilage but rather an extensive network of fibers within their walls, are only seen to the eighth generation, which corresponds to a diameter of about 1.5mm. Beyond the eighth generation, the bronchiolar walls are not resolvable by spiral HRCT unless abnormal. The terminal bronchioles are the 16th generation bronchioles and conduct into the lobules. Beyond the terminal bronchiole, 4-8 respiratory bronchiole are characterized by the presence of outpouchings representing alveolar structures. Each respiratory bronchiole leads to a series of alveolar ducts and terminal groupings of alveolar sacs (Wright et al., 1985).
Fig (3): Interstitial fiber network of lung. The axial fibers make up a strong connective tissue sheath that extends from the level of the pulmonary hila into the peripheral lung, to the level of the alveolar ducts and sacs. The peripheral fibers extend over the surface of the lung beneath the visceral pleura and penetrate inward from the pleural surface to marginate secondary pulmonary lobules thus forming the interlobular septa. A fine network of septal fibers within the alveolar septa supports the lung parenchyma. The septal fibers joint with axial and peripheral fibers network to form a continuous fiber skeleton for the lung. Although the axial fibers predominate in the central lung and peripheral lung, all fiber networks are represented at the level of the pulmonary lobule (Reid, 1959).

Anatomy of secondary lobule and its components:

For the purposes of interpretation of helical HRCT, secondary lobule is most appropriately conceptualized as having three primary parts:

A- The interlobular septa.
B- The lobular core structures.
C- The lobular parenchyma. (Weibel, 1963)
Fig (4): Anatomy of the secondary pulmonary lobule.

A-Interlobular septa:

Anatomically, secondary lobules are margined by connective tissue (interlobular septa) which extend inward from the pleural surface. These septa are part of the peripheral interstitial fiber system, which extend over the surface of the lung beneath the visceral pleura. Pulmonary vein and lymphatics lie within the interlobular septa that marginate the secondary lobule. The interlobular septa are thickest along the anterior, lateral and diaphragmatic lung surfaces, thus, secondary lobules are best defined in these regions.

Septa measure about 100 μm (0.1 mm) in thickness in a subpleural location (Murata et al., 1986). Within the central lung, interlobular septa are thinner and less well defined than peripherally, and lobules are more

Review of Literature
B- The lobular core:

The central portion of the lobule, also referred to as the lobular core contains the pulmonary artery and bronchiolar branches that supply the lobule, as well as some supporting connective tissue (the axial fiber system) (Murata et al., 1986).

The branching of the lobular bronchiole and artery are irregularly dichotomous. In other words, when they divide, they divide into two branches that are usually of different sizes, one branch is of nearly the same calibre while the other is smaller (Plopper, 1994).

C- The lobular parenchyma:

The substance of the secondary lobule, surrounding the lobular core and contained within the lung parenchyma, bordered by interlobular septa consists of the functioning lung parenchyma that contains nearly alveoli and the associated pulmonary capillary bed supplied by small airway and branches of pulmonary arteries and veins. This parenchyma is supplied by a connective tissue stroma, a fine network of very thin fibers within alveolar septa called the septal fibers by Weibel (Weibel, 1963).

The pulmonary acinus:

The pulmonary acinus is defined as the portion of the pulmonary parenchyma supplied by a first order respiratory bronchiole. Since respiratory bronchioles are the largest airways having alveoli in their walls, an acinus is the largest lung unit in which all airways participate in gas exchange. Acini measure about 6-10 mm in diameter, and a secondary lobule usually consists of a dozen or fewer pulmonary acini (Pump, 1969).