



Flow-volume loops. (A) **Normal.** Inspiratory limb of loop is symmetric and convex. Expiratory limb is linear. Flow rates at the midpoint of the inspiratory and expiratory capacity are often measured. Maximal inspiratory flow at 50% of forced vital capacity (MIF 50%FVC) is greater than maximal expiratory flow at 50% FVC (MEF 50%FVC) because dynamic compression of the airways occurs during exhalation. (B) **Obstructive disease** (eg, emphysema, asthma). Although all flow rates are diminished, expiratory prolongation predominates, and $MEF < MIF$. Peak expiratory flow is sometimes used to estimate degree of airway obstruction but is dependent on patient effort. (C) **Restrictive disease** (eg, interstitial lung disease, kyphoscoliosis). The loop is narrowed because of diminished lung volumes, but the shape is generally the same as in normal volume. Flow rates are greater than normal at comparable lung volumes because the increased elastic recoil of lungs holds the airways open. (D) **Fixed obstruction of the upper airway** (eg, tracheal stenosis, goiter). The top and bottom of the loops are flattened so that the configuration approaches that of a rectangle. Fixed obstruction limits flow equally during inspiration and expiration, and $MEF = MIF$. (E) **Variable extrathoracic obstruction** (eg, unilateral vocal cord paralysis, vocal cord dysfunction). When a single vocal cord is paralyzed, it moves passively with pressure gradients across the glottis. During forced inspiration, it is drawn inward, resulting in a plateau of decreased inspiratory flow. During forced expiration, it is passively blown aside, and expiratory flow is unimpaired. Therefore, $MIF_{50\%FVC} < MEF_{50\%FVC}$. (F) **Variable intrathoracic obstruction** (eg, tracheomalacia). During a forced inspiration, negative pleural pressure holds the “floppy” trachea open. With forced expiration, loss of structural support results in tracheal narrowing of the trachea and a plateau of diminished flow. Flow is maintained briefly before airway compression occurs.