

Assessing Health & Functional Fitness

RESPIRATORY HEALTH,
INTERPRETING DATA AND
REPORTS

Lung Function Testing (PFTs)

- Spirometry (FV loop spirometry, dynamic lung volumes)
- Reversibility testing
- Bronchial challenge testing
- Static lung volumes (TLC, FRC)
- Gas Transfer (DL_{CO} , TL_{CO} Transfer factor, K_{CO} ,)
- Maximal respiratory pressures (Mouth pressures)
- CPEST (Cardiopulmonary exercise test)

Indications for Spirometry

- Evaluate respiratory health
- Determine the presence and severity of a lung defect or dysfunction
- Monitor progress of lung conditions
- Assess efficacy of interventions on parameters of lung function
- For research

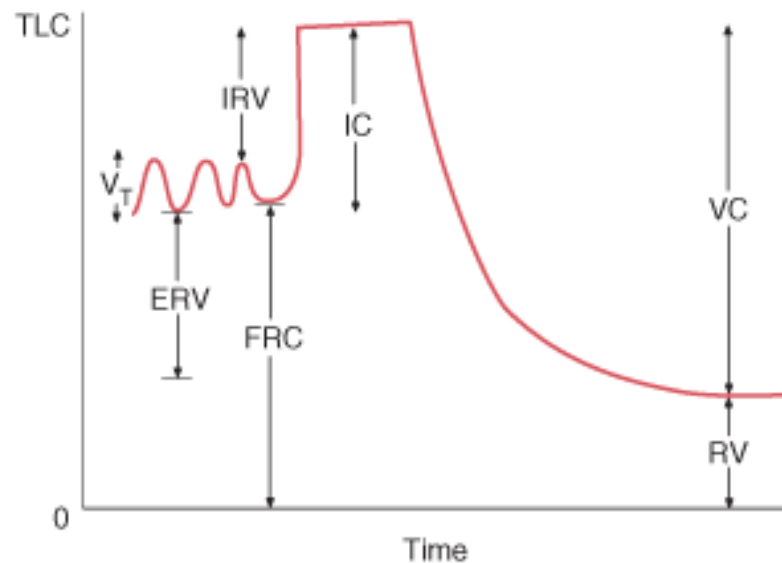
Contraindications for Spirometry

- It can generate high intra-thoracic pressures therefore anyone with the following conditions should be excluded:
 - Thoracic/abdominal surgery
 - Brain, eye, ear, nose, throat surgery
 - pneumothorax
 - Recent MI
 - Haemoptysis
 - PE
 - Unstable Angina
 - Uncontrolled BP (>200 Systolic >120 Diastolic)
 - Confused Patients
 - Infection
 - Participant Discomfort

Volume Time effects on Lung Function

ERV = expiratory reserve volume; FRC = functional residual capacity; IC = inspiratory capacity; IRV = inspiratory reserve volume; RV = residual volume; TLC = total lung capacity; VC = vital capacity; V_T = tidal volume.

$FRC = RV + ERV$; $IC = V_T + IRV$; $VC = V_T + IRV + ERV$.



General principles

- Technical factors
 - Operator
 - Patient
 - within test repeatability
 - Confounding factors
- Quality control – between test repeatability
- Appropriate reference values

Spirometry

- Measures the ability to move air rapidly
 - Depends on
 - Nervous system
 - MSK
 - Skin
 - Connective tissue
 - Lungs
 - Airways
 - Inhaled gas

How is the test done

- Apparatus
 - true spirometers - volume & time
- Method
 - Full inspiration, forced maximal expiration
 - Minimum 3 technically acceptable attempts
 - Within 5% repeatability FEV1 and FVC

Data generated

- Volume time curve (spirogram)
 - FEV1, FVC, Ratio
- Flow volume loop
 - Peak flow
 - FVC
 - FEF 25-75%
 - MEF 75, 50, and 25
 - Inspiratory flow data

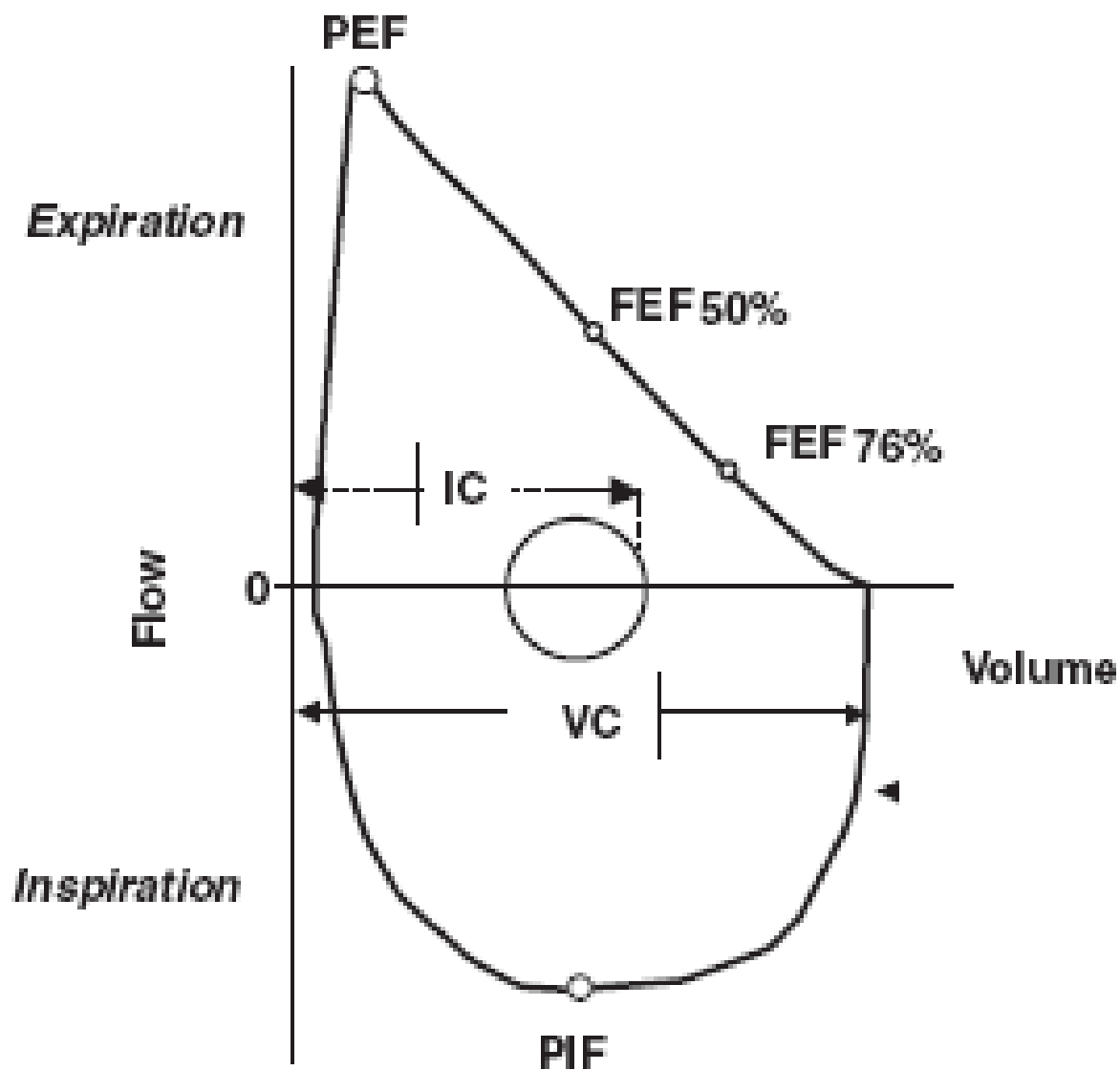
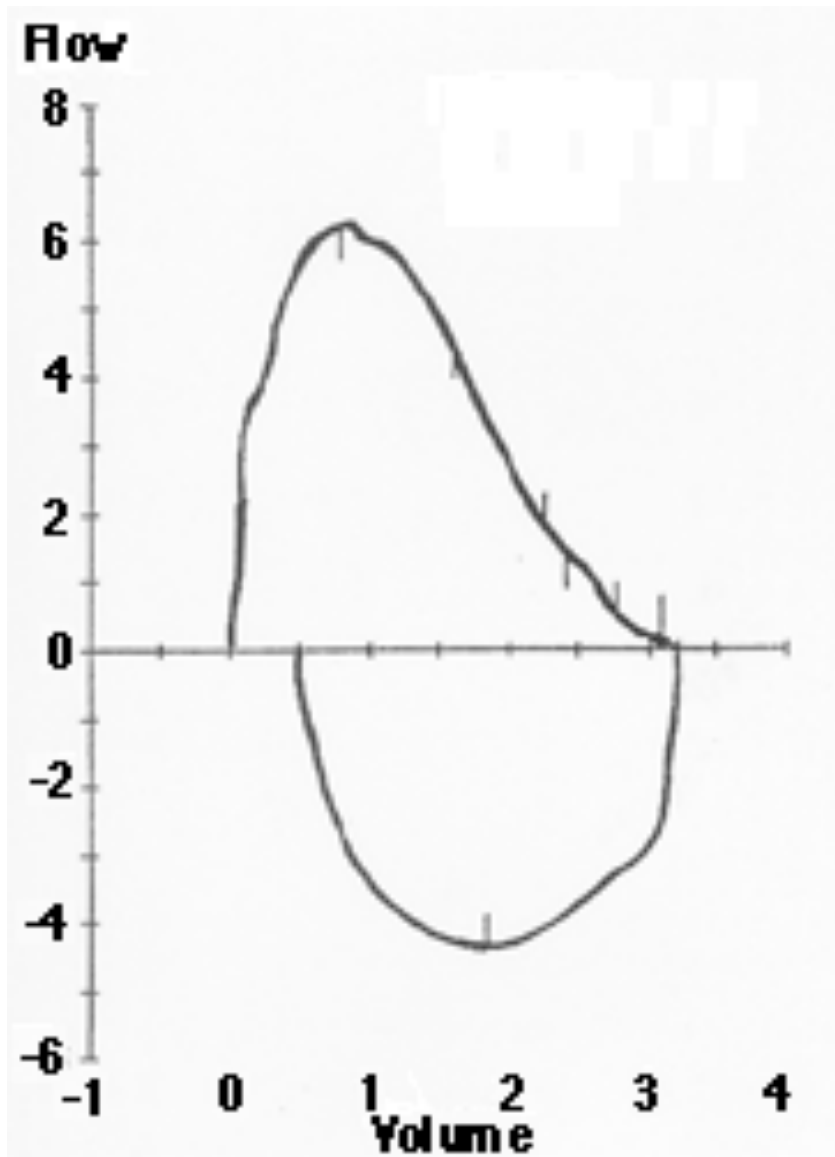
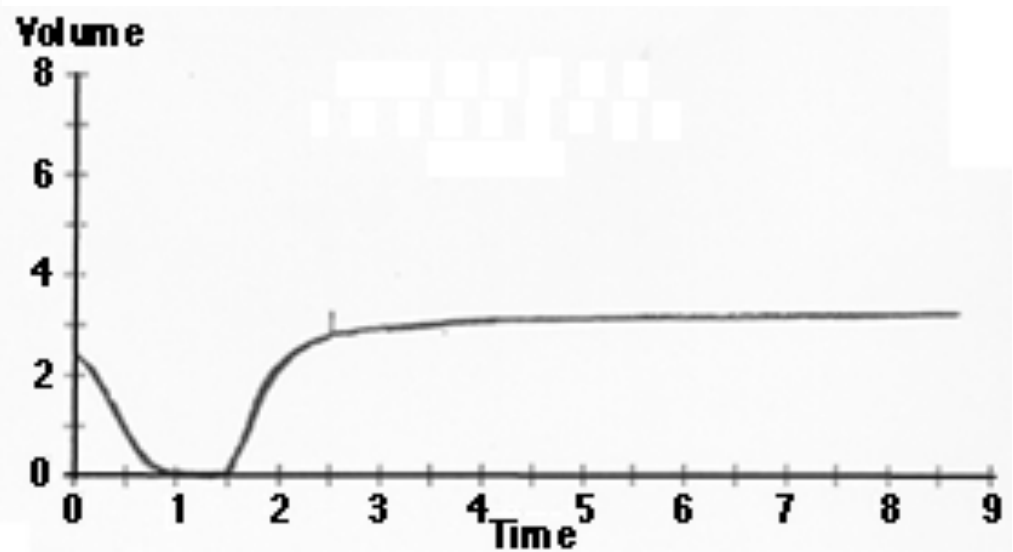


Figure 3 Flow volume curve for a normal subject showing the principal measures used.



NORMAL



Calculation of Values

- Obstructive v. Restrictive
- Mid flow obstruction
- Shape of the FV loop
 - Obstruction v. restriction
 - Fixed large airway obstruction
 - Variable airway obstruction
 - Extrathoracic
 - Intrathoracic

Spirometry interpretation

- Obstructive v. Restrictive
- Mid flow obstruction
- Shape of the FV loop
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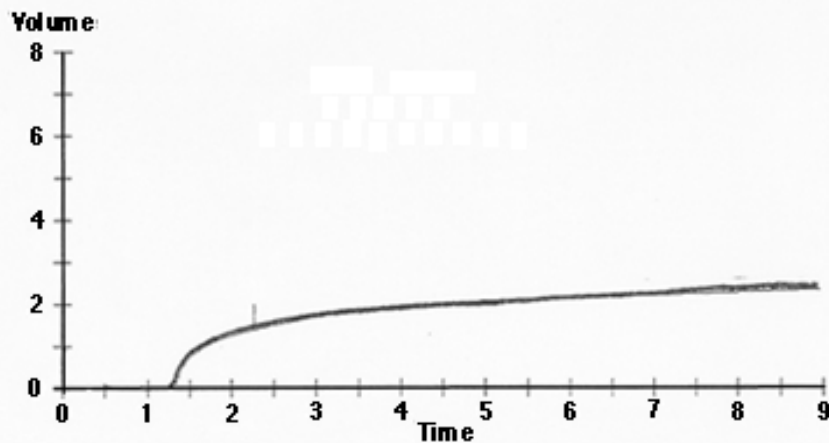
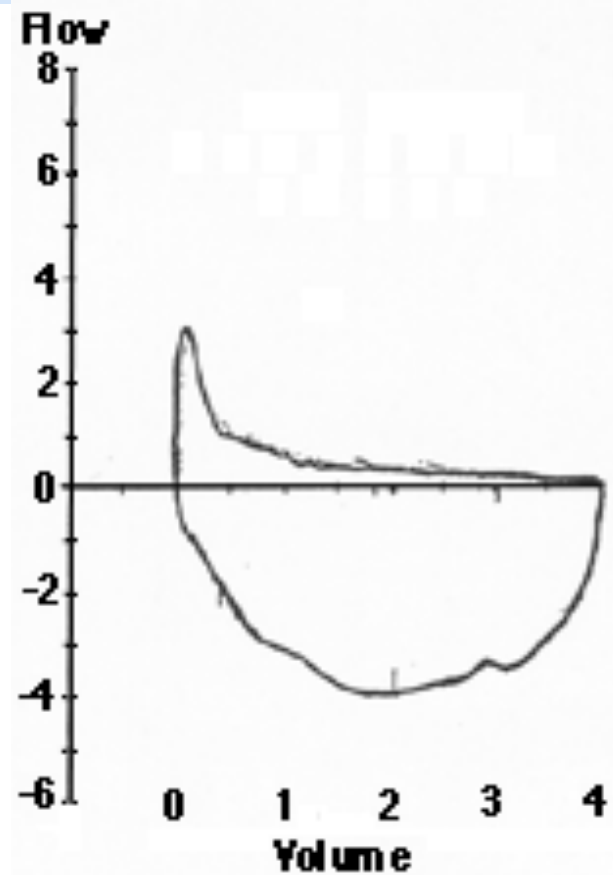
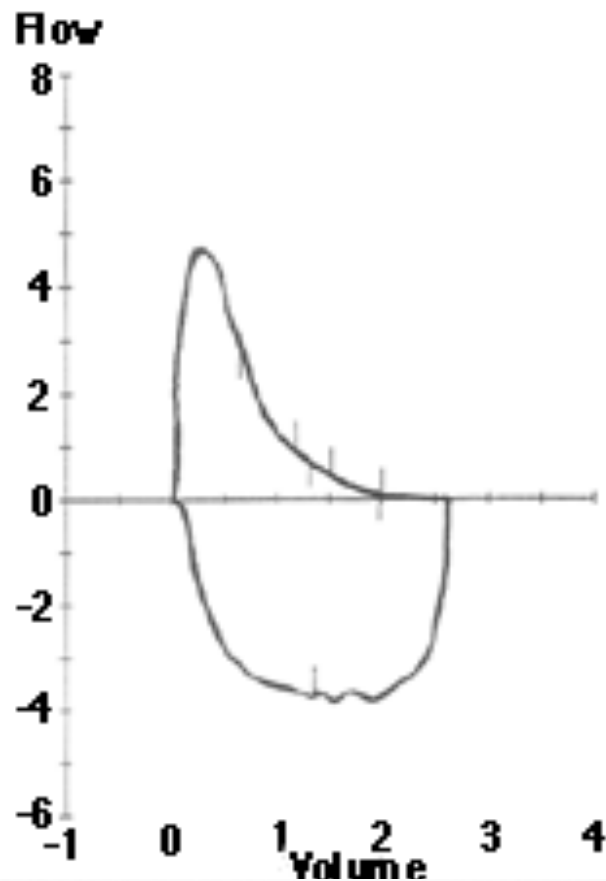
Obstructive

- COPD (Chronic Obstructive Pulmonary Disease)
 - Non-reversible
- Asthma
 - Can be reversible

Obstructive

Clinical features differentiating COPD and asthma

	COPD	Asthma
Smoker or ex-smoker	Nearly all	Possibly
Symptoms under age 35 years	Rare	Often
Chronic productive cough	Common	Uncommon
Breathlessness	Persistent and progressive	Variable
Night time waking with breathlessness and/or wheeze	Uncommon	Common
Significant diurnal or day to day variability of symptoms	Uncommon	Common



Airflow obstruction

Mild on left

Severe on right



Classification of COPD Severity by Spirometry

Stage I: Mild

$FEV_1/FVC < 0.70$

$FEV_1 \geq 80\%$ predicted

Stage II: Moderate

$FEV_1/FVC < 0.70$

$50\% \leq FEV_1 < 80\%$ predicted

Stage III: Severe

$FEV_1/FVC < 0.70$

$30\% \leq FEV_1 < 50\%$ predicted

Stage IV: Very Severe

$FEV_1/FVC < 0.70$

$FEV_1 < 30\%$ predicted *or*
 $FEV_1 < 50\%$ predicted *plus*
chronic respiratory failure

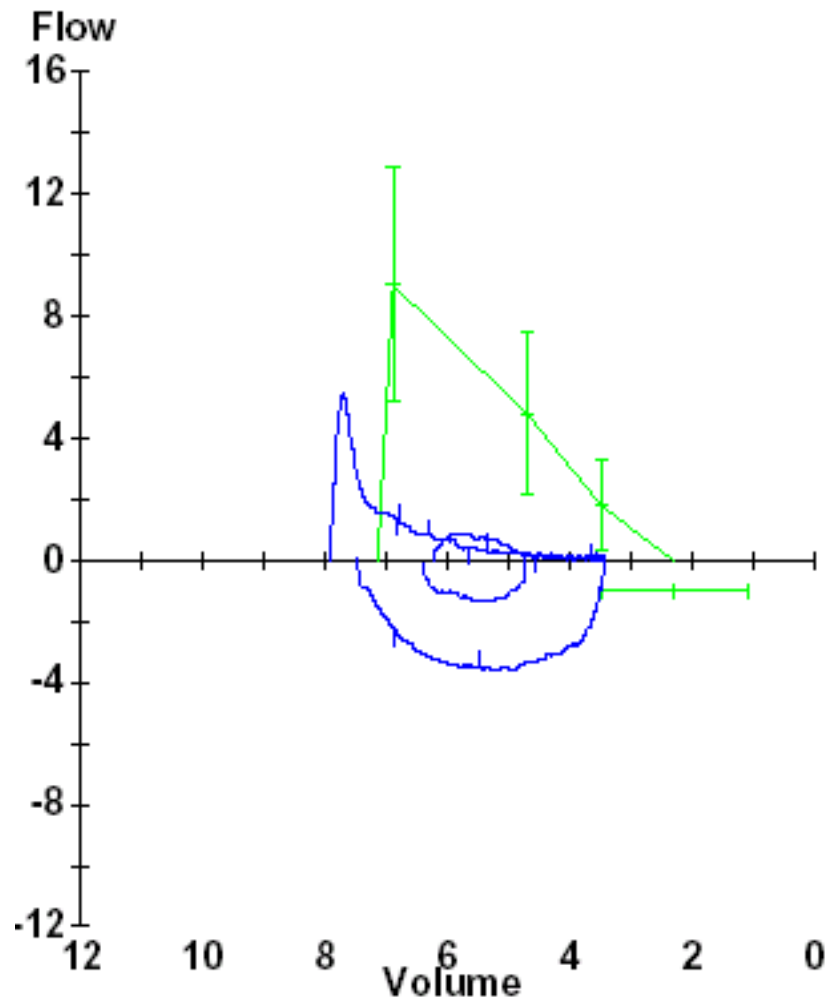
COPD

ID: CSM4166
Date: 10/03/04
Gender: Male
Age: 62

Weight(kg): 79.0
Height(cm): 184
BMI: 23.33

PB: 753
Temp: 23

		Pre	Pre	Post	Post
	Ref	Meas	% Ref	Meas	% Ref
Spirometry					
FVC	4.86	4.48	92		
FEV ₁	3.38	(1.61)	(48)		
FEV ₁ /FVC	70.0	(36.0)			
FEF ₂₅₋₇₅ %	3.11	(0.35)	(11)		
PEF	9.02	5.43	60		
Lung Volumes					
TLC					
RV					
RV/TLC					
FRC PL					
ERV					
VC					
Resistance					
Raw					
sRaw					
Diffusion					
D _{LCO}					
D _{LCO} /V _A					
V _A					



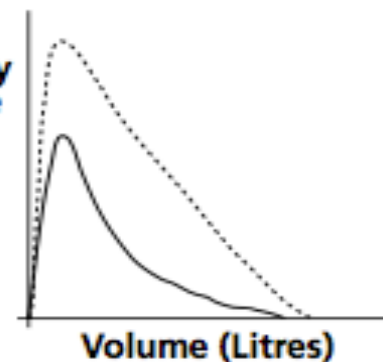
Comments:The patient could not fully expire during to FVC, therefore the results for both vital capacities may be underestimated. See attached FV loops

Identifying abnormalities with flow-volume curves

Obstructive disorder:

In this example of a patient with obstructive airways disease, the peak expiratory flow (PEF) is reduced and the decline in airflow to complete exhalation follows a distinctive dipping (or concave) curve.

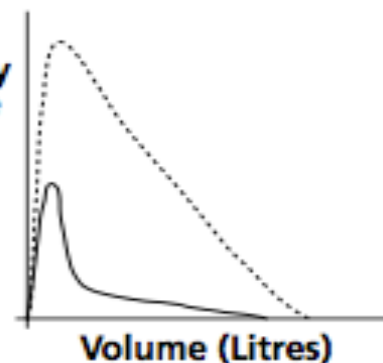
Expiratory
flow rate
(L/s)



Severe obstructive disorder:

In a severe airflow obstruction, particularly with emphysema, the characteristic 'steep pattern' is seen in the expiratory flow trace.

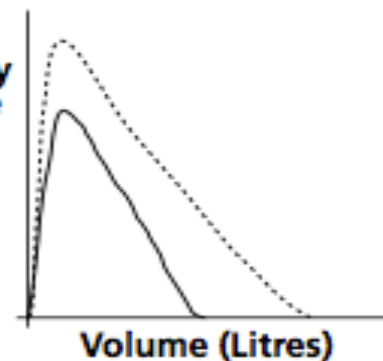
Expiratory
flow rate
(L/s)



Restrictive disorder:

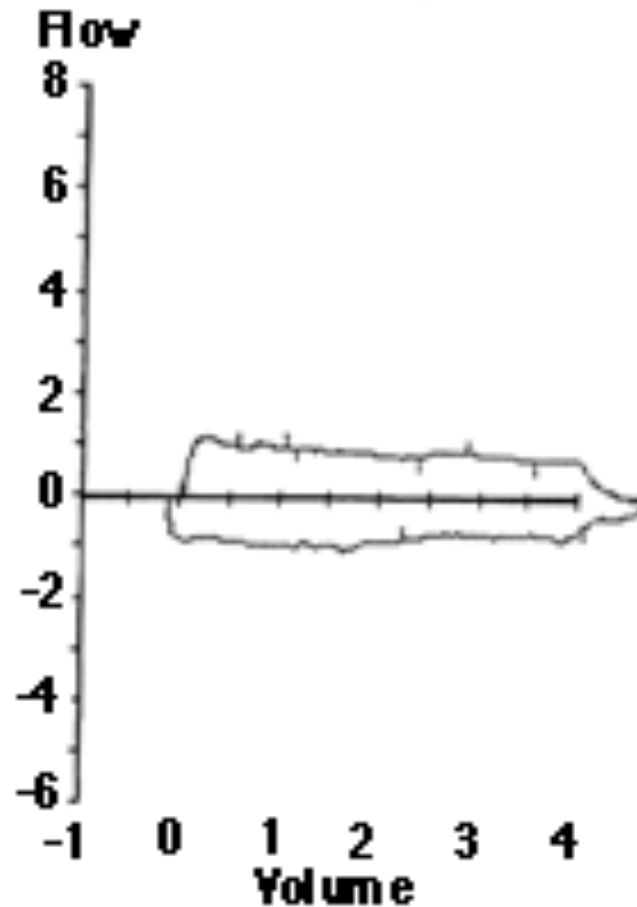
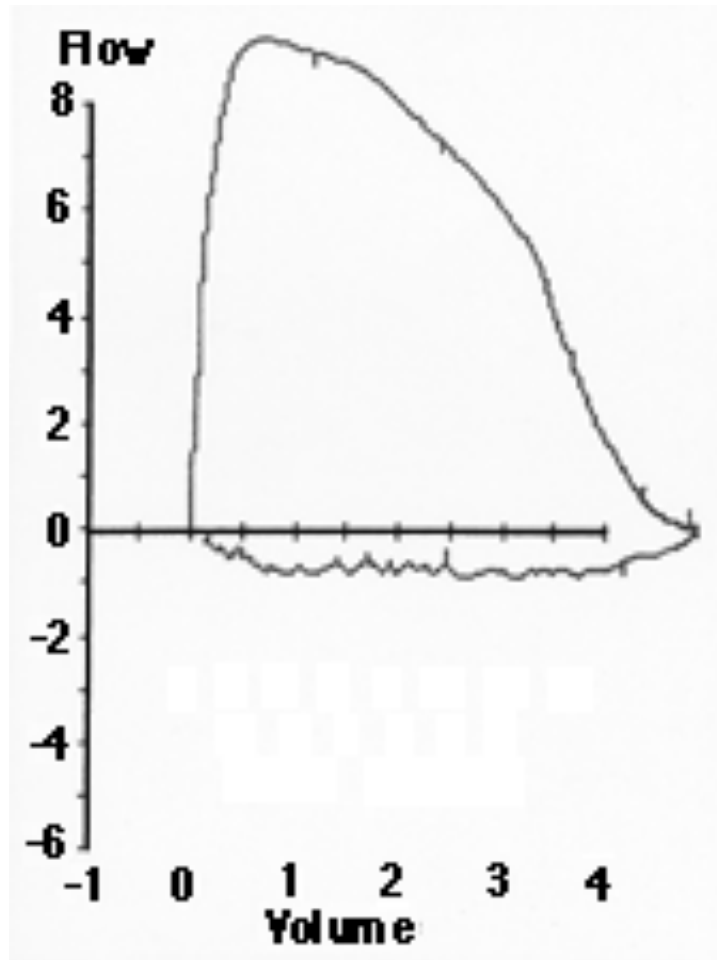
The pattern observed in the expiratory trace of a patient with restrictive defect is normal in shape but there is an absolute reduction in volume.

Expiratory
flow rate
(L/s)



Large Airway obstruction

- Tracheal
 - Fixed obstruction – expiratory and inspiratory limitation
 - Variable obstruction
 - Inspiratory limitation indicates extrathoracic obstruction
 - Expiratory limitation indicates intrathoracic obstruction



Variable extrathoracic

Fixed

Large airway obstruction

Reversibility

- How?
 - Off inhalers
 - Spiro
 - Inhaled bronchodilator
 - Check spirometry again
- Data
 - Absolute and % predicted pre&post FEV₁ & FVC

Interpretation

- Definition of significant response
 - FEV1 inc. by 15% AND 200ml
 - FEV1 or FVC inc. by 12% AND 200ml
- What does reversibility mean?
 - Reversible airflow obstruction
 - Asthma
 - COPD with reversibility
 - COPD + asthma

Bronchodilator Response PFT

ID: AKC1991

Date: 21/06/04

Gender: Male

Age: 40

Weight(kg): 96.0

Height(cm): 189

BMI: 26.87

PB: 745 Temp:

21

	Pre	Pre	Post	Post	Post	
Spirometry	Ref	Meas	% Ref	Meas	% Ref	% Chg
FVC	5.71	6.05	106	6.31	110	4
FEV ₁	4.27	3.74	88	4.27	100	14
FEV ₁ /FVC	74.0	62.0		68		
FEF ₂₅₋₇₅ %	4.19	(1.99)	(47)	2.66	63	33
PEF	10.27	10.19	99	9.4	91	-8

Lung Volumes

TLC

RV

RV/TLC

FRC PL

ERV

VC

Resistance

Raw

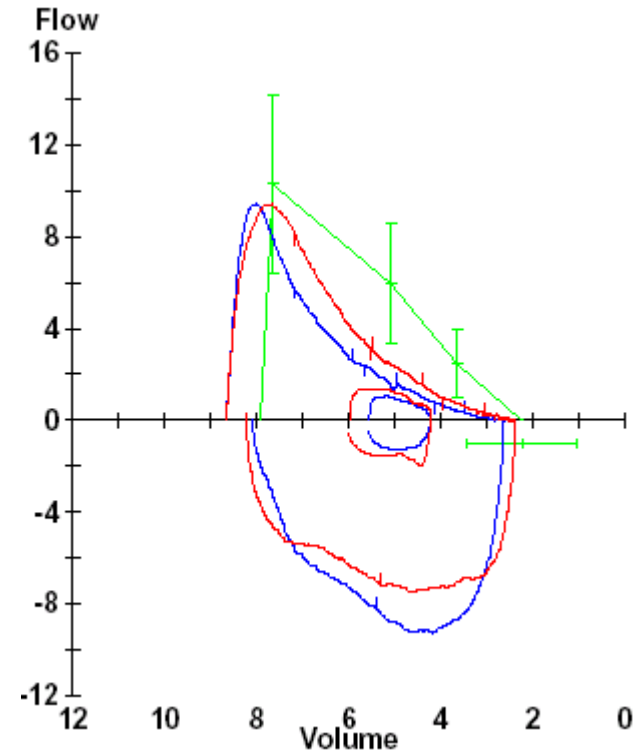
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Diffusion

D_{LCO}

D_{LCO}/V_A

V_A



Comments: Acceptable and repeatable results obtained. Ventolin (2.5gm) was administered for bronchodilator testing.

Interpretation:

Bronchial challenge testing -

- Often used for asthma diagnosis
- How?
 - Off inhalers
 - Check spirometry
 - Inhale a bronchoprovocator (histamine, methacholine, saline) at inc. concentrations
 - measure spirometry after each inhalation
- N.B. exercise as a bronchoprovocator

Lung volumes - interpretation

- True restriction - reduced TLC
- Hyperinflation - high TLC
 - Gas trapping - High RV, RV/TLC ratio
- Neuromuscular disease - ↓ TLC, preserved or raised RV

Other patterns

■ Obesity

- Restrictive Spirometry and TLC, very reduced FRC, reduced RV.

■ Heart Failure

- Obstructive in Acute, Restrictive in Chronic with decreased gas transfer.

■ Neuromuscular

- Decreased FVC, lower when supine, decreased TLC, preserved RV.