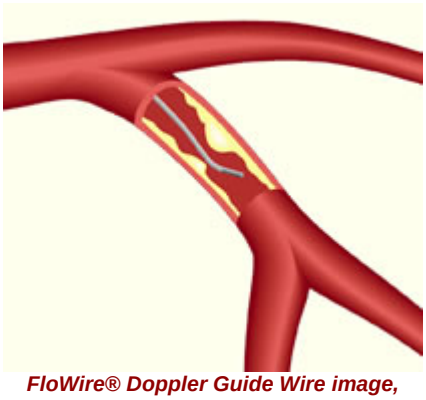
FRACTIONAL FLOW RESERVE

What is FFR?
Fractional Flow Reserve, or FFR, is a guide wire-based procedure that can accurately measure blood pressure and flow through a specific part of the coronary artery. FFR is done through a standard diagnostic catheter at the time of a coronary angiogram (a.k.a. cardiac catheterization). The measurement of Fractional Flow Reserve has been shown useful in assessing whether or not to perform angioplasty or stenting on "intermediate" blockages.



FloWire® Doppler Guide Wire image, courtesy Volcano Corporation

The point of opening up narrowings or blockages in the coronary arteries is to increase blood flow to the heart. But a number of studies have shown that if a "functional measurement", such as Fractional Flow Reserve, shows that the flow is not significantly obstructed, the blockage or lesion does not need to be revascularized (angioplasty) and the patient can be treated safely with medical therapy

How Can FFR Affect Treatment of the Patient?
For example, a lesion measures 50% on the coronary angiogram. The patient hasn't experienced symptoms, like angina or chest pain. Nonetheless the lesion can be seen clearly on the TV monitor in the cath lab. The cardiologist (and patient) may be tempted to stent the lesion (a.k.a. the stenosis) for any number of reasons. After all, there's a blockage there -- why not take care of it? This reaction has been referred to in the medical literature as the "oculo-stenotic reflex" -- you see a stenosis, so you open it up and stent it. However, a few minutes of measurement with a special guide wire may reveal that an intervention won't have a significant impact on this particular blockage. Being able to better select cases not only saves health care costs, but contributes to more appropriate patient care.

Recent studies, such as the COURAGE trial, have re-emphasized what all current medical guidelines recommend: that for low risk patients, even those experiencing angina, optimal medical therapy should be the initial treatment. For those patients whose disease progresses, or for whom chest pain is not alleviated, revascularization, either through angioplasty and stenting or surgery, should be performed. Fractional Flow Reserve can be a significant tool to help physicians in deciding whether to intervene or not.

Furthermore, studies such as DEFER, show that patients who have been screened out of angioplasty by using FFR have not experienced an increase in adverse outcomes. And in these studies, two-thirds of the patients were judged not to need an intervention with balloons or stents.

ComboMap® Pressure and Flow System image, courtesy Volcano Corporation

How Does Fractional Flow Reserve Work?
A very thin guide wire is inserted through a standard 4F or 5F diagnostic catheter during an angiogram. Because of the smaller size catheter necessary, this can be done as an outpatient procedure.

The special guide wire crosses the lesion and is able to measure the flow and pressure of the blood. Results are displayed on a special monitor (left) along with the "FFR value". Studies have shown that an FFR value less than 0.75 or 0.80 corresponds to inducible ischemia, and most likely will require interventional treatment. Blockages that score above this threshold can be safely and adequately treated by medical therapy without the need for angioplasty.

Is Fractional Flow Reserve a New Technology?
The concept of measuring the blood flow across a blocked area or stenosis is as old as coronary angioplasty itself. The first balloon catheters invented by Dr. Andreas Gruentzig included a special lumen (or channel) to

measure pressures at the proximal and distal ends. The waveforms were then displayed on a monitor in the cath lab. The greater the distance between the two pressures, the greater the blockage. Dr. Gruentzig would inflate the balloon several times, until he was able to get the two pressures close to each other, indicating that the blockage was now sufficiently open.

But to read the pressures, the balloon needed an extra lumen, which made the balloon too large to get through very tight lesions or into smaller arteries. Lower profile balloons were invented, but they could not measure pressures, so this concept of measuring pressures virtually disappeared, to the chagrin of a number of cardiologists.

Today, however, newer devices that use Doppler and other technologies allow these measurements using only a .014" guide wire -- no balloon needed.