## Review Article

# Fragmented QRS: What Is The Meaning?

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**Abstract**

Fragmented QRS (fQRS) is a convenient marker of myocardial scar evaluated by 12-lead electrocardiogram (ECG) recording. fQRS is defined as additional spikes within the QRS complex. In patients with CAD, fQRS was associated with myocardial scar detected by single photon emission tomography and was a predictor of cardiac events. fQRS was also a predictor of mortality and arrhythmic events in patients with reduced left ventricular function. The usefulness of fQRS for detecting myocardial scar and for identifying high-risk patients has been expanded to various cardiac diseases, such as cardiac sarcoidosis, arrhythmogenic right ventricular cardiomyopathy, acute coronary syndrome, Brugada syndrome, and acquired long QT syndrome. fQRS can be applied to patients with wide QRS complexes and is associated with myocardial scar and prognosis. Myocardial scar detected by fQRS is associated with subsequent ventricular dysfunction and heart failure and is a substrate for reentrant ventricular tachyarrhythmias.

**Key words:** fragmented QRS, myocardial scar, cardiac event

## Introduction

It has been show in some studies that a subtle abnormality within the QRS complex can represent conduction disturbance and myocardial scar. A notch in the QRS complex in patients with left ventricular hypertrophy has been suggested to be a result of an intraventricular conduction defect [1]. Injured tissue around an infarct scar resulted in the RSR' pattern of the QRS complex [2]. However, the diagnostic and prognostic values of these subtle abnormalities within the QRS complex were not clarified in prior studies. In 2006, Das et al. proved fragmented QRS complex in patients with coronary artery disease (CAD) was associated with myocardial conduction block due to myocardial scar detected by myocardial single photon emission tomography (SPECT). fQRS was defined by an additional R wave (R') or notching within the QRS complex (**Figure 1**). fQRS improved identification of prior myocardial infarction in patients who are being evaluated for CAD. Since that report, the usefulness of

fQRS for the diagnosis and prediction of prognosis has expanded to patients with ischemic and non-ischemic cardiomyopathy and patients with primary electrical diseases.

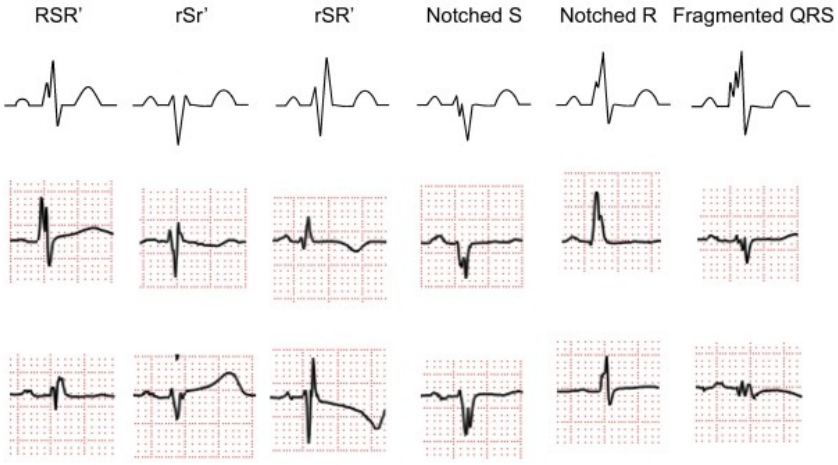


**Figure1.** Classification of fragmented QRS (various RSR' patterns). Fragmented QRS was defined as an additional spike of QRS complexes without bundle branch block. Various RSR' patterns are present in the mid precordial lead or inferior lead.

## Recording and definition of fQRS

ECG recording that is used to detect fQRS is not a specific setting and is the same as routine 12-lead ECG recording: high-pass filter: 0.05-20 Hz (usually 0.15 Hz), low-pass filter: 100-150 Hz, AC filter: 50 or 60 Hz, paper speed: 25-50 mm/sec (usually 25mm/sec) and voltage: 1mm/mV[3-5].

A low-pass filter is usually used to reduce electrical and musculature noises when recording the 12-lead ECG, but cut-off frequency of the low-pass filter influences detection of fQRS [6]. **Figure 2** shows effects of the low-pass filter on the detection of the small spikes. ECG recording with a low-pass filter of 35 Hz showed only 2 spikes (R waves) within the QRS complex. Increasing the cutoff frequency of the low-pass filter from 35 to 150 Hz unmasked 3 additional spikes within the QRS complex (**Figure 2**).

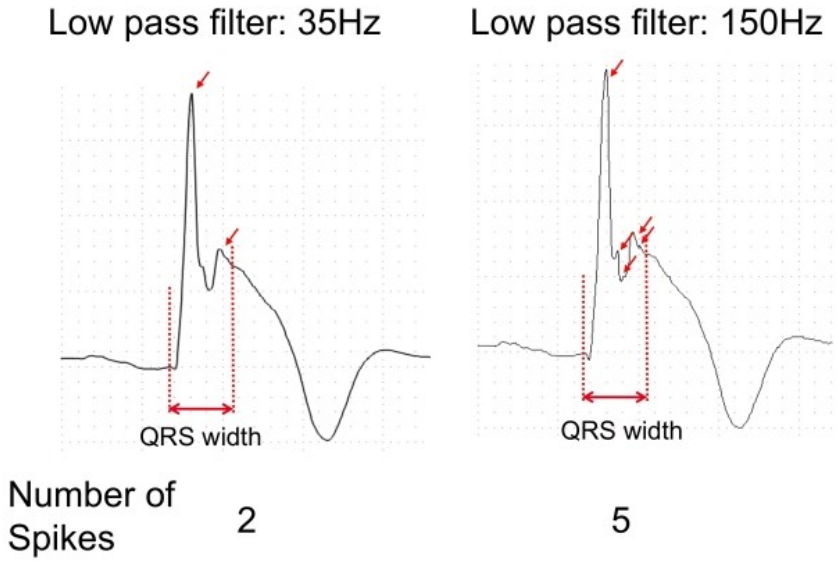


**Figure 2.** Effects of low-pass filter. ECG recording with a low-pass filter of 35Hz showed only 2 spikes within the QRS complex (left). Change of the cut-off frequency from 35 to 150 Hz unmasked 3 additional spikes within the QRS complex (right).