EMG Decomposition of Vastus Medialis and Vastus Lateralis in normal subjects and patellofemoral patients: A new way of assessing the balance of muscle function?

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Introduction
Much has been published on the electromyographic (EMG) differences between vastus medialis (VM) and vastus lateralis (VL), this work has mainly focused on the timing differences in the onset of muscle activation using surface EMG (1). However little has been reported on the frequency of the EMG signals which can indicate differences in motor unit firing patterns.

Method
This study used surface EMG signal decomposition technology to explore the properties of numerous simultaneously active motor units. EMG decomposition was conducted on VM and VL during a weight bearing closed kinetic chain isometric “squat” task (Figure 1) in pathology free individuals and case studies of patients with patellofemoral pain.

EMG signals were collected with two five-pin surface array sensors each providing four channels of data which were placed over the belly of VM and VL, Figure 2. Each channel was then sampled at 20 KHz using a modified 16 channel Bagnoli EMG system (Delsys Inc.). The signals were then decomposed into the constituent action potentials. The mean firing rate for each motor unit action potential train, the number of pulses per second (PPS), was then calculated.

Results
The results from the normal subjects support previous findings from VM and VL EMG decomposition with approximately equal firing rates of VM and VL, Figure 3. However, the results in the patellofemoral patients show clear differences between the firing rates in VM and VL, with VM having significantly greater firing rates than any previously published data from normal subjects (2), Figure 4.

Discussion
The ability to conduct surface EMG signal decomposition is a recent technological development. The elevated firing rate measured in the VM in this study could be explained in a number of ways. For example, this could be an indicator of localised muscle fatigue in the VM or it could indicate a change in recruitment pattern of the motorneuron pool. Either of these explanations could contribute to patellar mal-tracking.

Conclusion
Although exploratory at this time these differences in motor unit recruitment patterns between healthy subjects and patients with patellofemoral pain syndrome could represent an important future outcome measure of knee control when investigating patellofemoral pain. Certainly this is an area worthy of further study.

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References