

## Comparison of power spectrum measures to entropic measures of electromyography time series: Diagnostic tools for low back pain

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### Introduction

The use of surface electromyography (EMG) as a diagnostic tool for low back pain (LBP) is based on the possibility that changes in the fatiguing process can be monitored before the point of mechanical failure has been reached. However, back muscle fatigue studies do not consistently report endurance levels for patients with or without low back pain (LBP). This study is to evaluate a reliable diagnostic tool for low back pain based on power spectrum and novel technique based on nonlinear time series analysis, including entropy and mean square displacement.

### Methods

Ten subjects with chronic LBP and ten gender-matched volunteers were recruited as a control group. The endurance of the erector spinae muscle was determined using a modified version of the isometric Sorensen fatigue test. Using standard fast Fourier transform (FFT) of the surface EMG data, the median frequency, the slope of the median frequency, and the coefficient of determination ( $R^2$ ) were obtained. The signal was interpreted as a random displacement for each discrete time step, and the entropy and mean square displacement as functions of time were computed.

### Results and Discussion

The power spectrum measures do not provide a clear differentiation between LBP and healthy individuals. The median frequency was not statistically different between groups ( $T_{1,18} = 0.91$ ,  $p > .05$ ). However, the entropy and the mean-square displacement versus time exhibit a plateau for  $10\text{msec} < t < 1\text{sec}$  and both of these results were statistically different in the two groups (Figure 1).

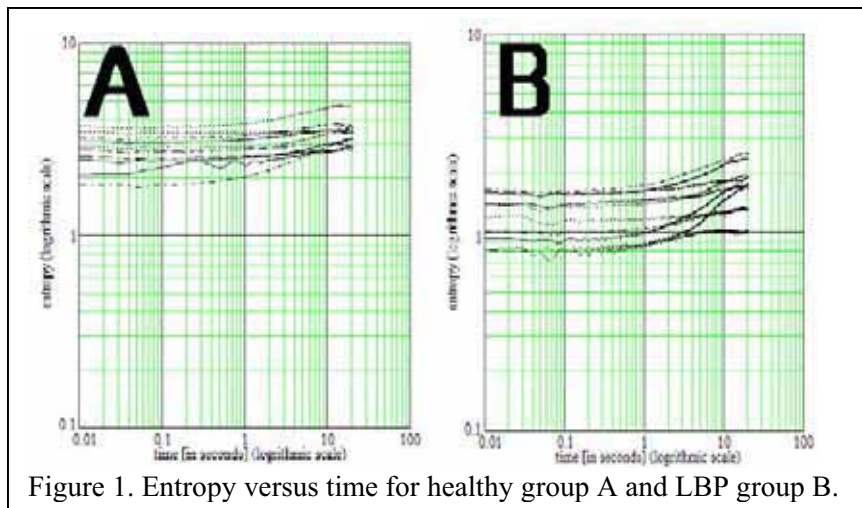


Figure 1. Entropy versus time for healthy group A and LBP group B.

### Conclusions

The mean-square displacement and entropy analysis are good diagnostic tools to diagnose LBP. The mean-square displacement versus time has a flat part, which reflects the presence of correlation in the EMG signal. In addition, the entropy values are larger for subjects without LBP than for those with LBP. Further study is required to understand the mechanism of action. The power spectrum seems to indicate a decrease in variability.

### References:

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