Muscle alterations in a Parkinson's disease animal model

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Introduction

Parkinson's disease (PD) is the second most common neurodegenerative disorder characterized by intracytoplasmatic aggregations of α-synuclein (α-syn) in dopaminergic neurons in specific regions of the central, peripheral and enteric nervous systems [1].
One of the most used animal models for research in Parkinson's Disease is obtained by intracerebral injections of the neurotoxin 6-hydroxydopamine (6-OHDA) that induce massive nigrostriatal pathway degeneration [2]. Electromyography (EMG) has demonstrated to be a reliable technique for extracting details about function of muscles implicated in motor deficits in a 6-OHDA rat model of PD [3]

In this work we have characterized the effects of a 6-OHDA-lesion model of Parkinson's disease on muscle function at different time post-lesion and have evaluated the frequency parameters as suitable biomarkers for detecting muscle dysfunction [4].

Methods

We have addressed the muscular activity characterization of a neurotoxic model of PD along six weeks post-lesion based on spectral and morphological analysis of electromyographic signals (EMG signals) obtained from biceps femoris muscle [5]. Power spectral densities (PSD) were characterized by the mean and median frequency and the morphological analysis was based on RMS amplitude

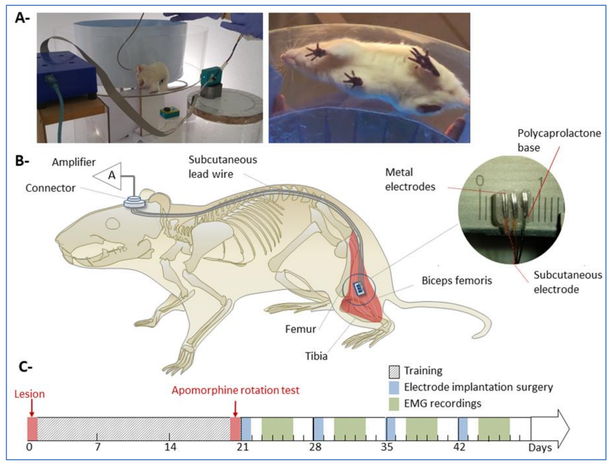


Fig.1 Experimental protocol and EMG subcutaneous electrode location in the rat hindlimb [4].
A) Pictures showing the experimental setup.
B) B) Electrode implanted in the rat's hindlimb *biceps femoris* muscle .
C) C) Temporal scheme of the experimental protocol.

Results

1) Spectral analysis of EMG recordings

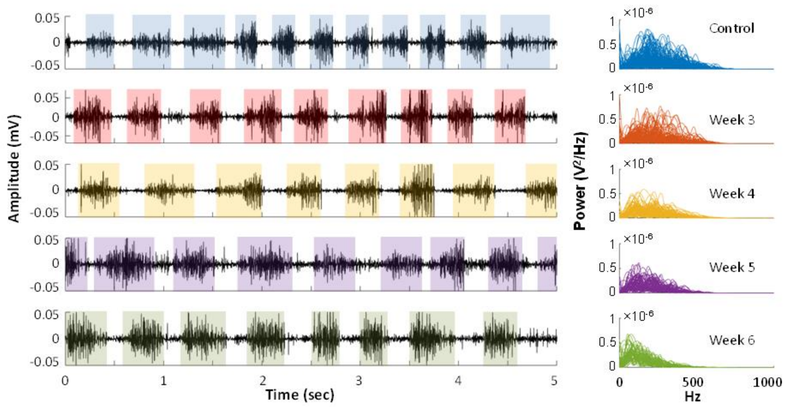


Fig 2. EMG recordings obtained from the BF muscle of rats at different time post-lesion. The column on the left shows the EMG recordings and the corresponding muscle contractions (shaded areas) obtained during the rat's gait. From top to bottom, recordings corresponding to: control, 3 weeks, 4 weeks, 5 weeks and 6 weeks post-lesion. In the column on the right, the power spectra (PSD) are plotted for the same conditions described on the left column.

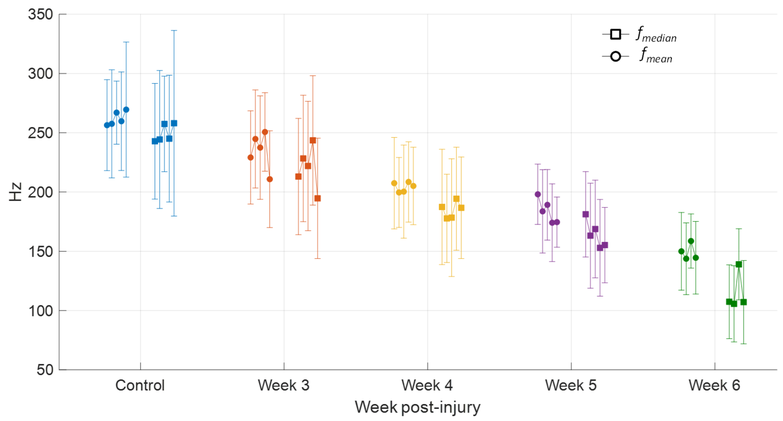
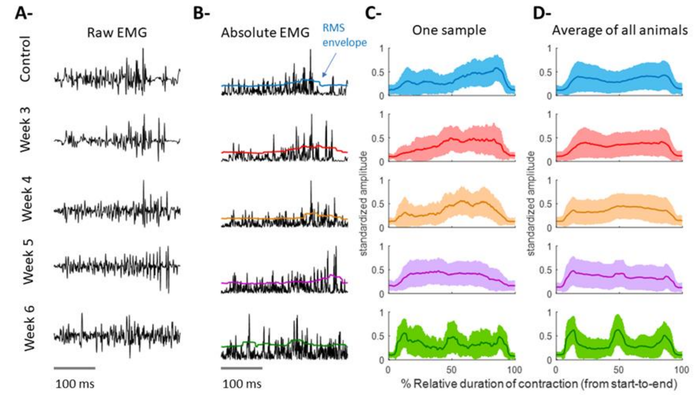


Fig 3. Frequency analysis. The mean frequency (fmean) and median frequency (fmedian) obtained for each experimental condition. Each error bar represents the average and standard deviation of at least one hundred electromyographic activations of each animal and each experimental condition.

The fmean and fmedian of each PSD were calculated for each animal and for each experimental condition. In general, as the time post-injury increases both frequency parameters decrease, as can be observed in Fig. 3. In all cases and in each experimental condition, fmean is greater than fmedian. In addition, the difference between both frequency parameters increases with the time post-injury.

More Results

2) Morphological analysis of the EMG *signal*



Discussion and Conclusions

In this work we have quantified muscle alterations of freely moving 6-OHDA-lesioned rats by using spectral and morphological analysis of EMG signals extracted from the rat's hindlimb muscle.
From the results we have concluded:

- EMG signals spectral contents progressively changes with the time post-lesion
- Contractile dynamics of BF muscle throughout its activation gradually changes with the time post-injury.
- Spectral frequencies parameters are suitable and competent estimators of muscle function.

Further investigations will be necessary to elucidate if the results presented in this work are the consequences of morphological alterations - fiber-type composition/innervation changes - or functional compensations to muscle dysfunction due to the central motor circuits alterations in this PD animal model.

References

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