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# Electron-Microscopic Investigation of Muscle Mitochondria in Chronic Fatigue Syndrome

## Key Words

Chronic fatigue syndrome  
Electron microscopy  
Fatigue  
Mitochondria

## Abstract

Patients with chronic fatigue syndrome (CFS) suffer from disabling physical and mental fatigue. Abnormalities in mitochondrial function can lead to fatigue and weakness. Ultrastructural mitochondrial abnormalities have been reported to be present in CFS patients. We obtained percutaneous needle muscle biopsies from 15 CFS patients and 15 age- and sex-matched controls. We investigated previously reported ultrastructural abnormalities in CFS: subsarcolemmal mitochondrial aggregates, intermyofibrillar mitochondrial aggregates, mitochondrial circumference, area, pleomorphism and the presence of compartmentalization of the inner mitochondrial membrane. All of the steps of tissue processing, electron microscopy and data abstracting and analysis were performed in a totally blinded fashion. All of our data were rigorously quantified. We found no difference in any of these studied parameters between CFS patients and controls. Although there is no ultrastructural mitochondrial abnormality in CFS patients, other lines of evidence suggest the presence of a possible functional mitochondrial abnormality.

## Introduction

Profound muscle fatigue, precipitated by minimal physical activity is one of the major symptoms in patients with Chronic Fatigue Syndrome (CFS) [1]. In CFS there have been reports of excessive intramuscular acidification [2] and abnormal jitter with single-fiber electromyography suggestive of abnormal muscle membrane function [3]. However, other investigators have not found abnormalities in muscle fatigability and excitation-contraction coupling [1, 4].

In vitro tests have shown depressed muscle mitochondrial respiration in CFS, and patients have demonstrated

reduced aerobic work capacity [5]. Mitochondrial palmitate oxidation has been reported to be reduced in CFS patients [6], and the intracellular concentration of ATP has been demonstrated to be reduced at peak exercise in CFS patients [7]. These results suggest a mitochondrial abnormality.

Ultrastructural abnormalities in muscle mitochondria from CFS patients have recently been reported [8-11]. Mitochondria are the source of energy production in cells and dysfunction of these organelles may be the cause of the fatigue seen in CFS. These investigations were performed at the Institute of Neurological Sciences in Glasgow, UK, under the direction of Dr. W.M.H. Behan.