A Novel Smartphone Application Can Detect Periodic Limb Movements

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Introduction
• Periodic limb movements (PLMs)
  - unconscious
  - involuntary
  - repetitive movements
  - of lower extremities that occur in sleep
• Jerky movements

Introduction
• PLMs are scored (American academy of Sleep)
  - 4 consecutive movements
  - Duration of 0.5-5 seconds
  - Separated by 5-90 seconds
  - 0.8 mV above resting voltage
• PLM index
  > 5 PLMs per hour of sleep = pathological

Introduction
• PLMD
• 80% of patients with Restless leg syndrome (RLS) have PLMs
Introduction

Treatment for PLMD:
- Dopaminergic agonists
- Benzodiazepines
- GABA agonists

Introduction

• Prevalence estimated to 4-11%
• Diagnostic challenge

Diagnostic gold standard:

Polysomnographic evaluation + bilateral anterior tibial electromyography (BATEMG)
Introduction

Limitations:
- Hospital environment
- One or several nights
- Uncomfortable
- Man-power
- Expensive

Actigraphy

Aim

To develop a limb movement sensing application (LMSA) for a smart phone using the built-in accelerometer
Aim

Objectives:

• Remote diagnosis and consultation
• Unlimited follow up
• Reduce cost and labor

Methods-

- LMSA created for iOS 5.x in Xcode
- Incorporated in iphone 4S (Apple INC)
- Code was written in Objective C
- Tri-axial accelerometer – detect movement continuously
- Numerical entity = acceleratory force in any or several of 3 axes
- Threshold of 0.2 was set after comparing to BATEMG

Methods-

- Data acquisition

32 yr healthy male

LMSA

BATEMG

iPhone: left leg: lateral mid-calf

iPhone 320 movements

400 leg movements

200 iPhone attached to the leg

200 iPhone under the bedsheet

50 PRONE

50 SUPINE

50 LEFT RECUMBENT

50 RIGHT RECUMBENT
Methods

Scoring:
- BATEMG data scored as per American Academy of Sleep Medicine guidelines
- Compared to LMSA auto scored data

Results

No difference in the mean number of recorded leg movements
\(50.4 \pm 0.51 \text{ vs } 49.0 \pm 3.7 \ p=0.3\)

Discussion

- LMSA accurately detects periodic limb movements
- Calculates PLM index

Uses:
- Screening for PLMD
- Follow up of patients after initiation of treatment
Discussion

Advantages
- Remote monitoring/ self monitoring at home
- Inexpensive
- Easy to use/ interpret
- No other equipment needed

Thank you