Exercise in Neuromuscular Disease

Dr Gita Ramdharry
Senior Lecturer in Physiotherapy
NIHR research fellow
Aim

- Outline of neuromuscular diseases
- Presenting problems
- Overview of evidence
- Issue with exercise in NMDs
- What can we surmise from the literature?
- How can I apply this?
Neuromuscular conditions

- Anterior horn cell
- Peripheral Nerves
- Neuromuscular junction
- Muscle
Neuromuscular conditions

Polyneuropathies

- Inherited
- Acquired
  - Metabolic
  - Alcohol
  - Vitamin deficiency
  - Inflammatory
Neuromuscular conditions

Polyneuropathies

• Inherited
• Acquired
  ◦ Metabolic
  ◦ Alcohol
  ◦ Vitamin deficiency
  ◦ Inflammatory
Neuromuscular conditions

Myopathies

- Inherited
  - Muscular dystrophies
  - Mitochondrial myopathies
- Acquired
  - Inflammatory
  - Critical illness
Presenting problems

- Primary muscle weakness
- Atrophy
- Secondary muscle weakness
Presenting problems

- De-conditioning
  - Evidence of reduced aerobic capacity
  - Evidence that they are under active groups

(Pollard et al 2010)
Presenting problems

- Fatigue
  - ~70% of people with CMT, myotonic dystrophy and FSHD report severe fatigue (Kalkman et al 2005)
  - One the three most disabling symptoms in CIDP/GBS (Merkies et al 1999)

“...it’s like packing up, it’s like my body’s letting me down and it’s telling me to stop now or you’re not gonna carry on...”

(Ramdharry et al 2009)
Presenting problems

- **Fatigue**
  - ~70% of people with CMT, myotonic dystrophy and FSHD report severe fatigue (Kalkman et al 2005)
  - One the three most disabling symptoms in CIDP/GBS (Merkies et al 1999)

“It really hurts when you hear other parents and other kids ... not only will they go and have a game of football they might have spent the morning doing the housework, ... then come home, do the tea, do the washing and sort out ... and there's no way you could even think about that”

(Ramdharry et al 2009)
Presenting problems

• Presenting impairments impact on quality of life
  ◦ Muscle weakness in various NMDs (McDonald 2002)
  ◦ Relationships between QOL and ambulation in CMT (Padua et al 2008)

• Links with QOL and participation
  ◦ Relationships between QOL domains (physical functioning, physical role etc) and occupation in CMT (Vinci et al 2005)
Evidence for exercise

Exercise for people with peripheral neuropathy (Review)
White CM, Pritchard J, Turner-Stokes L

Therapeutic exercise for people with amyotrophic lateral sclerosis or motor neuron disease (Review)
Dal Bello-Haas V, Florence JM, Krivickas LS

Strength training and aerobic exercise training for muscle disease (Review)
Voet NBM, van der Kooi EL, Riphagen II, Lindeman E, van Engelen BGM, Geurts ACH
Evidence for exercise

Exercise therapy and other types of physical therapy for patients with neuromuscular diseases: a systematic review (Cup et al 2007)

- MND: insufficient evidence for strengthening, aerobic training, or combination though the studies examined did show some improvements.
- PN: insufficient evidence for strengthening, or a combination of strengthening and aerobic training, though the studies examined did show some improvements.
- NMJ: indications for the effectiveness of breathing exercises in MG
- Muscle: insufficient evidence for strength training; indications that aerobic training has a positive effect; a combined approach also has a positive effect
Evidence for exercise

- RCT n=29 CMT; n=36 MD
- 24 weeks training of hip extensors, abductors and knee flexors and extensors

**Measures:**
- Maximum isokinetic muscle torques at four speeds (Cybex)
- Isometric muscle MVC
- Functional measures: stairs, chair rising, rising from supine, 50m walk, 6m walk
Evidence for exercise

- Questionnaires: disease related difficulties in ADLs
- VAS for difficulty with tasks

Outcomes:
- Improved isokinetic knee torques in CMT
- 6m walk time in CMT
- No significant effects in MD
Evidence for exercise

- N=34
- 52 weeks of isometric strengthening of elbow flexors and ankle DFs
- Elbow flexors: no improvement in isometric strength but an improvement in dynamic strength
- Ankle: no improvement

Strength training and albuterol in facioscapulohumeral muscular dystrophy

E.L. van der Kooi, MD; O.J.M. Vogels, MD, PhD; R.J.G.P. van Asseldonk; E. Lindeman, MD, PhD; J.C.M. Hendriks, PhD; M. Wohlgemuth, MD; S.M. van der Maarel, PhD; and G.W. Padberg, MD, PhD
(Gallardo et al 2005)
Evidence for exercise

- Functional training
  - Fewer studies, early results

RCT N=19
12 week programme of balance training

Measures:
Berg Balance Scale
Timed up and go
10m timed walk

Outcomes
Both groups improved balance score.

Disability and Rehabilitation, December 2006; 28(23): 1455–1459

RESEARCH PAPER

Effects of dynamic balance training during standing and stepping in patients with hereditary sensory motor neuropathy

ZLATKO MATJAČIĆ & ANTON ZUPAN
Institute for Rehabilitation, Republic of Slovenia

Accepted February 2006
Evidence for exercise

- Functional training

Pilot study 12 people
Two interventions: Treadmill, stretches and proprioceptive training versus respiratory, stretched and proprioceptive training. Three months training and 6 months washout

Measures:
MRC scale, Tinetti balance scale, LL performance scale, O₂ consumption, lung function
Evidence for exercise

- Fatigue

52 weeks of training for 65 people with FSHD

- Experienced fatigue measured using the Checklist Individual Strength

- No change in fatigue levels
Evidence for exercise

• Fatigue

ABSTRACT: Exercise intolerance and undue fatigue are common complaints in patients with Charcot-Marie-Tooth (CMT) disease. Reduced physical ability is due directly to the disease, but it is also due to physical deconditioning. The aim of this study was to test whether 24 weeks of interval-training exercise (ITE) cycling can significantly improve physiological, neuromuscular, and functional capacities and alleviate fatigue in CMT patients. Eight CMT patients (4 CMT1A and 4 CMT2) participated in ITE for 3 nonconsecutive days per week. Cardiovascular fitness, muscle strength, fatigue resistance, and functional capacities were measured before and after 12 weeks of supervised hospital training and again after another 12 weeks of unsupervised home training. Training was well tolerated. There were significant improvements in cardiovascular capacities, isokinetic concentric strength, and functional ability measurements. All patients experienced an improvement in their self-reported visual analog scale for fatigue and pain during training. However, there was no significant change in their isometric force production and indices of fatigue resistance after training. Although the improvement in exercise tolerance may be due in part to reversal of the deconditioning effect of their related sedentary lifestyle, this clinical trial suggests that ITE can benefit CMT patients especially in their functional performance and subjective perception of pain and fatigue. Moreover, the improvement observed at the end of the first supervised period ITE was maintained after the second unsupervised home period, although there was no further improvement in performance and tolerance.


BENEFITS OF INTERVAL-TRAINING ON FATIGUE AND FUNCTIONAL CAPACITIES IN CHARCOT-MARIE-TOOTH DISEASE

LHASSAN EL MHANDI, MSc,1 GUILLAUME Y. MILLET, PhD,1 PAUL CALMELS, MD,2 ANTOINE RICHARD, MSc,1 ROGER OULLION, MD,2 VINCENT GAUTHIERON, MD,3 and LEONARD FEASSON, PhD2

1 Unit of Physiology, Physiopathology of Exercise and Handicap, Faculty of Medicine Jacques Lisfranc, University Jean Monnet, and Units of Sport Medicine and Myology, Bellevue Hospital, 42055 Saint-Étienne, France
2 Department of Physical Medicine and Rehabilitation, Bellevue Hospital, University Hospital Center, Saint-Étienne, France
3 Department of Clinical Physiology of Exercise, Units of Sport Medicine and Myology, Bellevue Hospital, University Hospital Center, Saint-Étienne, France

• N=8, no control group
• 24 week program of bicycle based interval training
• Measures:
  - Isokinetic knee torque
  - VAS for fatigue
• Improved VAS for fatigue during exercise but no change after
Evidence for exercise

- Fatigue
  - 12 week unsupervised training
  - Combination of strength, aerobic, task specific training
  - In addition to increases in strength, improved fatigue, anxiety and depression

[Image: A prospective study of physiotherapist prescribed community based exercise in inflammatory peripheral neuropathy]

R.C. Graham
R.A.C. Hughes
C.M. White

DOI 10.1007/s00415-006-0335-4
Safety

- People with NMDs traditionally told not to exercise
- Concerns about worsening the condition
- Concerns about eccentric exercises
Muscular dystrophies, e.g., dystrophinopathy

sarcolemmal leakage, Ca**-influx, oxidative stress

Muscle-fiber denervation

denervation, withdrawal of myotrophic factors

caspase cascade activation, TUNEL (TUNEL+) DNA-fragmentation

(Tews 2006)
Normal

Acute Polio

Recovery

Post-Polio Syndrome

(Trojan 2005)
Safety

- People with NMDs traditionally told not to exercise
- Concerns about worsening the condition
- Concerns about eccentric exercises
- In inflammatory NMDs concerns about increasing inflammation (serum CK)
- In mitochondrial myopathies, concerns about increasing the mutant mtDNA load (Taivassalo et al 2006)
Safety

- Exercise trials conducted in many conditions
- May not show efficacy, due to design
- Often monitor potential deleterious effects
- Beckers MD, LGD, myotonic dystrophy: no deterioration in muscle histology or serum CK
- Inflammatory myopathy: no change in serum CK
- Mitochondrial myopathy: no increase in mutant DNA load with endurance training (? decrease after exercise)
Safety

- Inflammatory neuropathy: no deterioration with strengthening or aerobic training
- PPS: no deterioration in motor unit number with training of hand muscles
- CMT: no increase in weakness of the dominant hand
- Polymyositis: case study demonstrated no deterioration with submaximal eccentric exercises
Barriers to exercise


• 13 people with varying NMDs, 18 healthy controls
• Modified Barriers to Physical Activity and Disability survey
• Mean of 7 barriers identified by NMD group and 3 by controls
• Most common:
  – Lack of energy
  – Lack of motivation
  – Feeling self-conscious
  – Boring
  – Cost
Barriers to exercise

CMTUK AGM workshop on exercise

- 31 out of 40 people there exercised regularly

- Number of days per week exercising
  - Number of people:
    - <1: 4
    - 1: 3
    - 2: 7
    - 3: 4
    - 4: 3
    - 5: 6
    - 6: 2
    - 7: 1

- Duration of exercise
  - Number of people:
    - 1 to 15: 2
    - 16 to 30: 10
    - 31 to 60: 14
    - 60+: 2
Barriers to exercise

**Benefits:**
- Improved balance
- Improved flexibility
- Feel refreshed
- Relaxed
- Feel more toned
- Easier breathing
- Easier sleep
- Reduce fatigue
- Control body weight

**Barriers:**
- Pain: joints and muscles
- Cramp (some during, some after)
- Work
- Getting to facilities
- Reduced endurance
- Feeling of exhaustion
- Told not to by consultant
- Fear it could worsen symptoms
- Access
- Lack of facilities
- Local pools too cold
- Balance
Barriers to exercise

Recommendations from those who exercise regularly:
Be more creative with exercises e.g. use tins of beans
Choose something you enjoy
Do something purposeful
More privacy at the gym away from “buffs”
Exercise bike in the garage
Conclusions and interpretation

- Exercise in NMDs is safe
- **May** be beneficial: early positive results
- **May** be a difference in response between conditions
- Carry over into function of more traditional training?
- **May** be less able to strengthen weaker muscles
Conclusions and interpretations

• May/may not improve strength function health and well being effects must be considered to reduce other risk factors
• Not enough evidence yet to ascertain if high intensity eccentric contractions are safe
• Little guidance on optimal dosage
• More research required!
Recommendations for practice

• Promote from a health and well being perspective
• Specific training protocols
• Caution with very weak muscles until we have more evidence
• Caution with eccentric exercises until we have more evidence
Recommendations for practice

- Use perceived exertion scales for patients to monitor during exercise
- Perhaps look at combining with task specific training
- Supervision and monitoring
- Patient preference
- Non-exercise activity?
Acknowledgements

References:
Please email  g.ramdharry@sgul.kingston.ac.uk