Muscle Strengthening – Lessons learnt from the Children!

Sue Maillard
Clinical Specialist Physiotherapist in Paediatric Rheumatology
Great Ormond Street Hospital
London. UK
Myositis

- Juvenile Dermatomyositis
- Dermatomyositis
- Polymyositis
- Inclusion Body Myositis
Causes of Muscle Weakness

- Inflammation
  - Acute onset

- De-conditioning
  - Muscles loose strength within 24-48 hours
  - Maximum muscle strength lost in 1st 6 weeks
  - Muscles only recover with use.
Why Weaker Muscles?

- Pain
  - Inflammation
  - Biomechanical
- Reduced movement
- Reduced activity
- General ‘un-wellness’
- Muscle imbalance
- Disease activity
- CYTOKINES

Petersen AM J physiol & pharm 2006; Mathur N Med of Inflamm 2008
Biomechanical Changes

- Inflammation is patchy
- Muscle imbalance
  - Strong muscles get stronger
  - Weak muscles get weaker
- Abnormal forces through joints
- Joint instability
- Fatigue
Why Weaker Muscles?

- Pain
  - Inflammation
  - Biomechanical
- Reduced movement
- Reduced activity
- General ‘un-wellness’
- Muscle imbalance
- Disease activity
- CYTOKINES

Petersen AM J physiol & pharm 2006; Mathur N Med of Inflamm 2008
TNFα

- **Inhibits contractile function**
  - Reduced contractile force
  - Blunts muscle response to calcium activation

- **Causes muscle atrophy**
  - Increases proteolysis
  - Inhibits insulin effect upon muscles
  - Blocks glycogen uptake in muscles

- **Chronic increase:**
  - Inhibits skeletal muscle synthesis
  - Causes skeletal muscle myopathy
TNFα has a normal bi-phasic response in muscle growth

TNFα

Increase in MM cells

Apoptosis of mature cells

Mature MM cells

TNFα
IL-6

► Pro-inflammatory cytokine
► Normally produced by working muscles

Controlled by:

► TYPE OF EXERCISE
  ► Eccentric > Concentric
  ► Endurance > resistance
► Dependent on effort and time
► Glycogen availability
► Normal response

► Metabolism control
  ► Glucose homeostasis
    • Insulin-stimulated glucose disposal
  ► Lypolysis
    • Fatty acid oxidation

Pederson BK J appl physiol 103; 2007; Winkelmann C; AACN Clinical Issues, 2004
Cytokines and Exercise

Excessive eccentric, endurance and strenuous exercise causes an increase in cytokine production:

→ Local muscle inflammation → Local muscle damage → degrading necrotising mm cells →

Muscle repair

Requires ↑Glycogen supplies
Moderate progressive resisted exercise programmes:

► Reduce normal production of:
  › IL-6
  › TNFα

► Improves the bodies homeostasis abilities
  › Efficient use of glycogen and Lipolysis
  › Less muscle inflammation (lower CRP)

(Kasapis C, J of Am Coll Cardiology 45; 2005)

AND THEREFORE ARE ANTI-INFLAMMATORY

Muscle Repair

► Satellite Cells
  › Muscle precursor cells
  › Replace muscle cells
  › Increase number of muscle cells
  › Form new fibres or repair damaged segments

► Stimulated by exercise
  ► Daily exercise after damage encourages repair.
  › Finite number
    ► Max no. @ birth, start to ↓ from 9 years
Common Pattern of Weakness in Most Conditions

- Hip Abductors
- Hip Extensors
- Inner range Quads
- Plantar flexors
Causes of Fatigue

- Inflammation
- Active disease
- Muscle weakness
- Specific muscle fatigue
- Deconditioning
- Reduced Aerobic fitness

- Emotional factors
- Psychological factors
  - Perception of illness
  - Perception of normal fatigue levels
To Explore the Use of the Paediatric QoL Subjective Questionnaire to Assess levels of Fatigue in children with JDM
A. Hasson et al – abstract published

- Parent reported PedsQL Fatigue did not correlate with disease activity
- Childs PedsQL Fatigue did correlate with disease activity
- FVAS correlated with disease activity
- There were a number of patients who reported high level of fatigue with no objective markers of disease activity
  - Need to consider psychological factors
Your Strength and Recovery

- Maximise what you can
  - Strength
  - Stamina – specific and general
  - Energy levels
  - Pacing

- Doing something is better than nothing!
Simple vs Complex Exercise

- **Simple Exercise (Correct biomechanics)**
  - Hip abduction
  - Straight leg raise etc

- **Complex exercise (General fitness)**
  - Walking
  - Running
  - Football
How to train muscles

- Specific muscles and Aerobic Training
- High repetitions
  - Less than 15 reps is not effective, ideal is 30 reps
- Low weights (0.5 – 5kg)
- Regular
  - 2x week better than 1x week, 4x week is best
- Regular progression
  - Daily/weekly is better than monthly

Faigenbaum AD, Rhea MR, Avery D, Hostler D and American College of Paediatrics
Home Management Programme

- Easy to do at home
- Progressive
- Specific
- Functional?
- Not too long
- Once a day
Suggested HEP

- Straight Leg raises
- Hip Abductors (backward banana’s)
- Hip Extensors
- Tiptoes 1 leg
- Core central stability
Knee Straightening
- Vastus Medialis

- Main protector of the knee
- Only extends the last 10-20’ of extension
- The most important muscle for standing and walking straight.
- Easily inhibited
- Straight Leg Raise = most effective exercise
Hip Abduction

- Vital to stabilise the pelvis especially during walking
- Vital for core central stability
- Positioning is vital
  - Slight hip flexion enables Psoas to take over
  - Gluteus medius needs slight extension at hip
  - External rotation (turning hip out) also inhibits Psoas
Hip Extensors

- Power muscle for walking and climbing stairs
- Knee extended
  - Hamstrings and gluteus maximus
- Knee Flexed
  - Gluteus maximus only
Plantar Flexors (Tiptoes)

- Propulsion during walking and running
- Full strength is single leg stance
- Full stamina
  - 10 reps 1 leg full ROM
Exercises need to be progressed
Muscle Memory

It is important that the muscles increase:

STAMINA

STRENGTH

However these are lost after 6 weeks of no exercising! (De-conditioning)

If the strength training is maintained long enough (over 4 months) then the memory of the strength remains and regaining lost strength and stamina is easier.
Aerobic Fitness

- Specific exercises – high reps with weights
- Sport (care with biomechanics)
  - Reduced WB
    - Cycling / swimming / horse riding / rowing etc
  - Full WB
    - Walking (power) / Running / football / basket ball etc
Sport

- FUN
- Varied
- Any Sport
  - Trampolining?
- Pain afterwards if common and means you need to do more NOT LESS!

- NEED TO BE FIT FOR THE SPORT
  - Table tennis vs Rugby
Progressive, resisted exercises to regain:
  - muscle balance
  - control of joint biomechanics

Balance and proprioception education

Functional activities

Increase generalised stamina

Increased confidence with own physical abilities:
  - In rehabilitation
  - With family

Thank you for listening and good luck!