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Interventions in Neurodisability – what works? BACD Annual Conference 2009 : Derby

Physical Management of children with cerebral palsy-
What is the evidence?
What works?

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Talk outline

- Setting the scene
 - Cerebral palsy as a health condition
 - Evolution of therapy interventions
- What is the evidence that therapy works?
 - What is evidence?
- What therapies are available?
- What evidence is there for physical therapies?
 - Examples from the literature
- What is the future?

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Definition of cerebral palsy:

“..... persistent disorder of posture and movement caused by non-progressive defects or lesions of the immature brain”, Aicardi & Bax, 1998

“.. Describes a group of disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing foetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, cognition, communication, perception, and/or behaviour, and/or by a seizure disorder.”
Rosenbaum et al 2005.

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Therapy for children with cerebral palsy: evolution

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Mayston, 2007

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International Classification of Functioning Disability and Health (WHO: 2001, 2002)

Palisano et al, in Campbell et al, 2006

<http://www3.who.int/icf/icftemplate.cfm>

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What is evidence?

(based on Brown et al 2003, Sackett 1997)

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Reflection on the evidence for what works

- Therapy is an integral part of CP management (Blauw-Hospers & Hadders-Algra, 2005), and it can be assumed for other neurological conditions
- Just because there is no evidence we should not discard empirical strategies that seem to work.....
- Aspire to the goal of evidence (experimentally) based practice
- Also important to consider the importance of evidence based practice for therapists' own professional development and for the benefit of users and service providers

"if the evidence base for management (of IH) were ice, I would not walk on it, even if I were a duck" (Kennedy, 2007; though not discussing CP)

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Management of CP-named and other approaches

(based on Mayston, 2004)

- Bobath / Neurodevelopmental (NDT): Bobath, 1980; Mayston, 1992; 2001; See Butler & Darrah 2001; Damiano 2007; Scrutton 2008)
- Conductive Education (Petó): Hari, 1980; Baird et al 1993; Darrah et al 2004)
- Patterning: (Doman-Delacato / B.I.B.I.C./ Brainwave)
- Task specific training: (Ketelaar et al, 2001)
- Targeted training: training postural activity (Butler 1998)
- M.O.V.E : (van der Putten et al, 2005)
- Sensory integration (Ayres, 1972; White, 1984; Blanche 1995)
- Vojta/ Katona: (von Aufschneider, 1992)
- Advance Neuromotor Rehabilitation (Advance)/ Scotson
- ADELI suit and programme.
- Alternative therapies eg. acupuncture, osteocraniosacral therapy, hyperbaric oxygen (Liptak et al 2005; Rosenbaum 2003)

But, research shows that no one particular approach is better than another, nor is the basis of any one approach clearly understood or based on sound evidence.

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Emerging therapies/interventions for physical management

- Botulinum toxin A: spasticity management
- Muscle strengthening: some evidence to suggest it might be useful for some children (Damiano et al 2002; Dodd et al 2002; Taylor 2007).
- Constraint induced therapy: mostly applied to chronic adult stroke but studies of its use in children now emerging (Taub et al 2001; Naylor & Bower, 2005; Gordon et al 2007; Juenger et al 2007)
- Treadmill training: limited evidence but could assist in training walking, improving transfers and improving fitness (Schindl et al 2000; Dodd & Foley 2007; Provost et al 2007)
- Orthotics/ lycra garments: several manufacturers; limited evidence (Attard & Rithalia, 2004)
- Recreational activities: e.g. hydrotherapy/ aquatic therapy, hippotherapy/ horse riding

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Emerging therapies/interventions for physical management

- Botulinum toxin A: suggested that intensive therapy input required following injection (APCP guidelines; also see review Lanin et al 2006)
- Muscle strengthening: took a back seat for many years due to fears of increased spasticity, currently no evidence to support this hypothesis
- Constraint induced therapy (CIT): based on animal model of cortical reorganisation, extensively studied post-stroke in adults. Taub 1980; Nudo 1996.
- Treadmill training: based on the idea that the spinal cord has central pattern generators which generate locomotor activity independently from supraspinal areas.
- Orthotics/ lycra garments: rigid vs flexible materials; range of different types but most with flexible materials require that the person has some effective activity to enable successful application.
- Recreational activities: every person has the right to exercise and government directives would indicate this should be a priority area for all citizens. No strong evidence for effective exercise programmes for children with CP (review: Verschuren et al 2008)

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Examples from the literature:

Review of the literature of research into management of CP

Review of physical therapy intervention for CP: Antilla et al (2008) based on Cochrane review guidelines.

- 21 systematic review of *randomised controlled trials* (RCT; 23) and *observational studies* (104) investigating the effectiveness of physical therapy interventions on functioning in children with CP.
- 22 RCTs identified; 8 intervention categories identified (comprehensive through to specific interventions).
- Moderate evidence for effectiveness of upper extremity treatments on attained goals; prehensile hand treatment & NDT on neurodevelopmental status; CIT on amount and quality of hand use.
- Conflicting evidence for strength training on gross motor function (see also Taylor 2007).
- Low evidence for other interventions e.g. balance training, hippotherapy.

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Review of the literature of research into management of CP

Review of RCTs by Antilla et al (2008)

Conclusion:

- Moderate but mostly limited evidence of the effectiveness of various PT interventions
- No exactly similar intervention studied in more than one trial
- Need well designed, focussed trials and new methods for analysing effects of comprehensive PT interventions.

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Review of the literature on research for Bobath/NDT management of CP

AACPDM evidence report for NDT Butler & Darrah (2001):
 Used levels of evidence: level I = RCT; level V = descriptive case series, expert opinion, anecdotes, from which no conclusion can be drawn.

- 21 studies identified
- 14/21 = level I or II – relatively credible
- Participation not discussed in any of the studies
- Sample sizes small; power calculations reported for only 2 studies
- ? Validity and sensitivity of measures
- No advantage of NDT over that to which it was compared, although some, albeit limited, evidence for immediate change in dynamic range of movement
- More intensive therapy did seem to confer greater benefit
- Longer follow-up studies needed to determine effects of NDT on contractures /deformities

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Review of the literature on research for Bobath/NDT management of CP: AACPDMD evidence report for NDT Butler & Darrah (2001):

Issues in determining effectiveness:

- Not specific treatments and not delivered in a standardised manner
- No discrete dosage or amount of time in therapy
- Variability of the therapists skill level
- Cannot standardise the child's family
- Changes in constructs of Bobath /NDT over time
- NDT strategies combined with other therapy techniques and medical treatments
- CP is a highly heterogeneous condition
- Ongoing challenge of growth and development

Conclusion about Bobath/NDT: No evidence to suggest Bobath/NDT is better than any other approach, but no evidence to suggest that it was less effective.

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Review of the literature on research for Conductive Education for the management of CP: an AACPDMD report

AACPDM evidence report for Darrah et al (2004):

- 15 studies in the review out of 88 citations: of these only 1 provided strong evidence, 13 weak.
- Implementation of conventional CE difficult due to lack of written guidance
- Problems with heterogeneity and it is possible that any positive effects for particular children could have been lost: need 'best-fit' intervention for child and specific intervention
- Changes in constructs of CE over time
- No conclusive evidence for or against CE
- Essential to define the parameters of CE.

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Effective strength training for children with CP?

- 14 children aged 6-14 with spastic diplegia, 6 weeks, X3 weekly, ankle weights @65% maximum (Damiano et al 1995)

Fig. 1. Comparison of quadriceps strength in controls, and in children with CP before and after training.

Fig. 2. Normalised knee flexion strength in controls, and in children with CP before and after training.

Reduction in amount of hip/knee flexion; improved gait velocity (Damiano et al 1995); less agonist/antagonist co-contraction (Damiano et al 2000)

Improvement in GMFM (11 children with diplegia and hemiplegia, 1998)

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Effects of strength training for people with CP

See review by Dodd et al 2002: 23 articles selected for detailed review, 11 met criteria for quality, only one RCT, 1 review.

No studies relating to strength training and bone density although there are studies on weight bearing and BD.

- No negative effects such as loss of range of movement, increased spasticity
- 8 out of 10 reported strength increases as a result of strength training programme
- 2 studies reported improvement in activity (function)
- 1 reported self-perception

Conclusion: "training can increase strength and may improve motor activity in people with CP without adverse effects"

Taylor, 2007: review of controlled trials: Conclusion: "No clear pattern of strength gains after training but no negative effects; more high quality controlled trials needed. Jury is out."

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What are physiotherapists working with children with CP doing to improve muscle strength?

- Repetition- how many?
- Manual resistance- how much?
- Use of body weight as resistance- is it enough?
- Free weights- are these appropriate?
- Endurance vs strength training (e.g, Liao et al 2006)
- Other possibilities- activity-based, gymnasium based programme, circuit training etc???
- Physiological limitations (e.g. Frieden & Lieber, 2002, 2003)

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CIMT for children.....

At least 14 studies but mostly single case studies and little evidence of how changes were produced by the CNS except for studies by Sutcliffe et al 2007; Juenger et al 2007. Single case study of modified CIT showing changes in cortical organisation which were maintained at 6 month follow-up (shift in laterality index as shown by MEG); 4/10 showed increased cortical activation shown by fMRI in the study by Juenger et al (2007).

Cochrane review (Hoare et al 2007, update 2009); 3 studies identified from the controlled trials reviewed. Conclusion: should be considered 'experimental'.

Many questions related to its use in clinical practice.

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Possible effects of treadmill training

- Improvement in overground walking. (Dodd & Foley 2007; Begnoche et al 2007)
- Improved walking velocity (Dodd and Foley 2007)
- Increase in muscle strength eg Andersson et al 2003
- Improved fitness/endurance (Provost et al 2007; Mayston et al 2006)
- Improved ability to perform standing transfer in the more severely disabled child/adolescent; 6 non-ambulant children out of 10 (Schindl et al 2000)
- Improved GMFM scores (Cherng et al 2007; Begnoche et al 2007; Schindl et al 2000)
- Increased muscle extensibility?
- Opportunity for inclusion rather than exclusion

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How important is passive stretching? See Pin, 2006 (CP)
Postural management? See Gericke, 2006, consensus statement

- (1) "there appears to be some evidence favouring passive stretching in increasing range of movements in children with CP, although the effect size remained small;
- (2) there is some favourable evidence indicating that passive stretching may reduce spasticity in children with CP although the effect size and clinical merit remain limited; *and*
- (3) there is some evidence to indicate that sustained stretching is preferable to manual stretching in improving range of movement and reducing spasticity in targeted joints and muscles in studies of children with spasticity".

"Clinically there are many children with CP, particularly those profoundly impaired, who like passive stretching as they feel it prevents muscle cramps and gives them a chance to change their position. Parents of these children also like passive stretching as they feel that they 'are doing something for their children'".

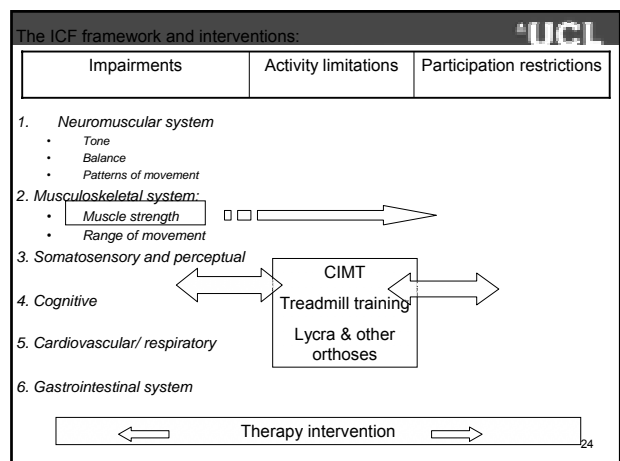
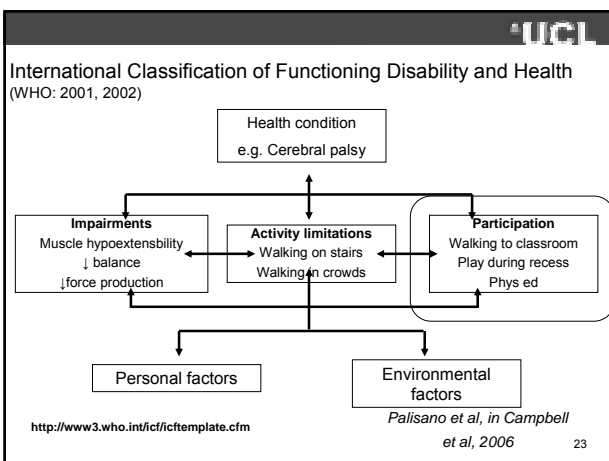
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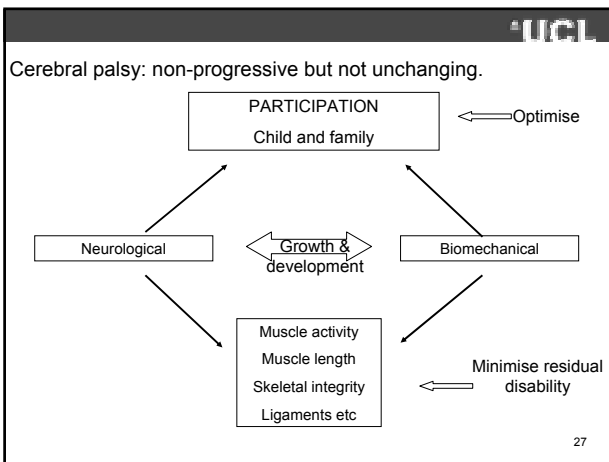
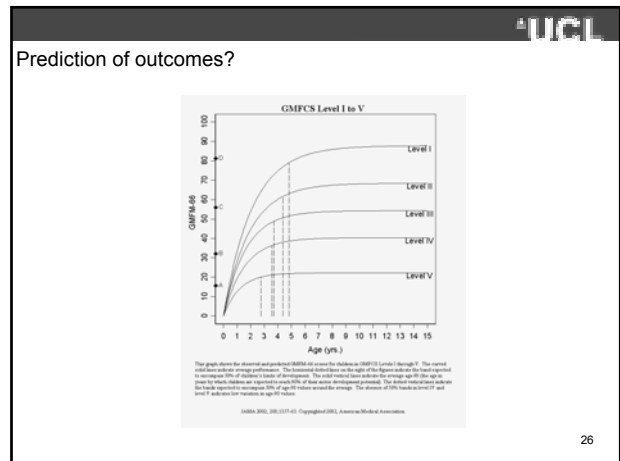
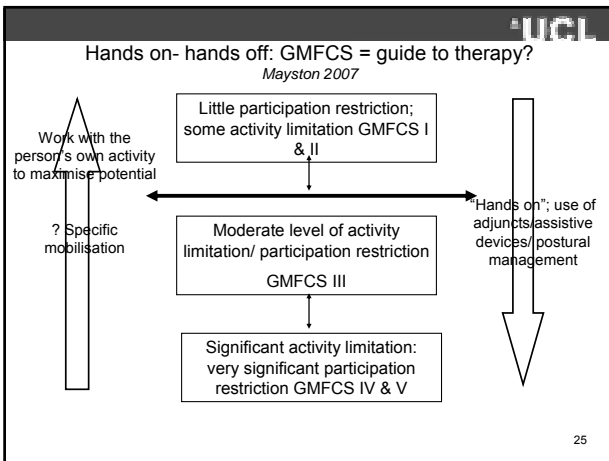
Intensity of therapy?

- Bower et al 2000, 2001:
 - Intensive physiotherapy, in contrast to collaborative goal-setting, did produce a very small improvement in the Gross Motor Function Measure scores. This effect declined in the follow-up period.
- Tsorlakis et al 2002:
 - intensity- X2 weekly vs X5 per week for 16 weeks. GMFM showed that more intensive NDT resulted in better outcome. Conclude that intensity is needed for effectiveness (n=34; heterogeneous).
- Weindling et al (2006):
 - extra therapy from therapy assistant made no difference for the group of young children with CP studied.

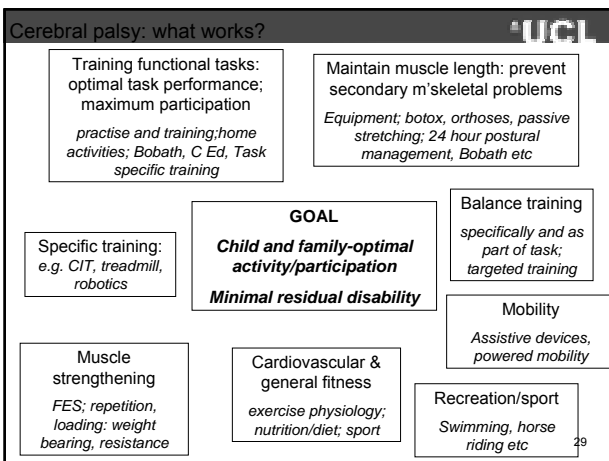
Highlights need for longitudinal studies, but also to define what is meant by therapy and what the goal of therapy should be.

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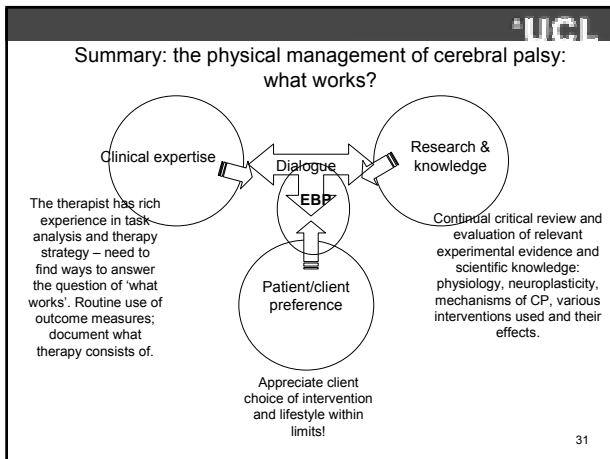




- ### Other considerations.....
- #### Family/child centred approach..... changing role of the therapist
- The client i.e. child and family is the expert in consideration of their own needs
 - He/she is the expert regarding experiences and preferences regarding physical activity
 - Shared decision making is expected to be the norm
 - Programmes need to be successful: compatibility, compliance, opportunity for active involvement, meaningful experience (Cup & Pieters, 2009)
 - Quality of life considerations
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- ### How?
- #### How to determine what works?
-
- Clearly defined protocol – accurate reproducible definition of intervention strategies
 - Appropriate, sensitive outcome measures – combination of measures to measure quality of movement e.g. kinematics (Kluzik et al 1990), neurophysiological (Damiano et al 1995), activity/participation, possible use of Goal attainment scaling (GAS), child/family QOL
 - Appropriate sample size: Pilot study followed by full study with power calculation
 - Select more homogeneous samples
 - Involve multiple sites
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- Summary – what works?**
- Some moderate evidence for several types of motor therapy but no robust experimental evidence base for the motor management of wide range of children with cerebral palsy.
 - Some evidence for a few treatments that work for a few types of children e.g. muscle strengthening, treadmill training, immediate effects of Bobath /NDT on dynamic muscle range.
 - Need a systematic study of the different types cerebral palsy: both mechanisms and functioning, as a basis for intervention (neurophysiology, biomechanics, functional outcome measures; use of different classification systems e.g. GMFCS; MACS etc)
 - Well constructed studies of different types of intervention – not approaches but specific elements of what therapists do, to enable determination of effects of these specific interventions and possible limitations: i.e. what works best and for whom?
 - More studies needed with children level IV/V GMFCS
 - Until there is robust comprehensive experimental evidence, need to look to physiology, principles of learning, neuroplasticity. *What seems key for successful outcomes is functional relevance, practice and a realistic manageable programme which is part of daily life.*
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