Articles in this issue ...

Modified constraint induced movement therapy for young children with congenital hemiplegic cerebral palsy: a randomised controlled trial

Functional outcome of children at six years after neonatal encephalopathy: a pilot study

Systematic Review - Do strengthening exercises improve function in patients with cerebral palsy?

Financial implications of case management during transition: a case report
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Email your submission in the first place in Word format to va@apcp.org.uk, clearly indicating the nature of the submission e.g. case series, research project.

Ensure that your copy includes information about the author (full name, qualifications, email address).

Once your submission has been received you will receive feedback from the reviewers indicating whether the copy has been accepted for publication.

There are a number of levels of acceptance:

- acceptance: no amendments required;
- acceptance: minor amendments required;
- acceptance major amendments required;
- rejection: not suitable for publication in the APCP Journal.

Annual Conference of the Association of Paediatric Chartered Physiotherapists

‘Challenging Clinical Practice’

4th & 5th November 2011
Radisson Blu, Stansted

CALL FOR CONFERENCE ABSTRACTS

Abstracts should be submitted by 1st July 2011 in electronic format to the APCP Administrator - va@apcp.org.uk.

The abstracts will be selected by peer review according to the ‘Guidance for Submitting Abstracts’ that is available from the APCP website or from the APCP Administrator.

Four abstracts may be chosen for oral presentation. Other selected accepted abstracts will be presented in poster format.

The selected abstracts may be published in APCP’s Conference Proceedings.
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EDITORIAL

Eva Bower – APCP Editor

Welcome to this the first of the 2011 issues of the APCP Journal. APCP has formed a new editorial board to produce your journal in which each board member has a designated an area of responsibility with certain tasks to perform.

Services for children with disabilities have come a long way since the days of Tiny Tim whose problems were compounded by poverty and lack of a diagnosis. It has been suggested that his disability was caused either by renal tubular acidosis, or by rickets due to a lack of Vitamin D (Lewis, 1992). Let us hope that services in the UK will not regress too much in the coming years. Paediatric physiotherapy also needs to progress towards producing a scientifically based journal included in a health database.

The three clinical articles published in this issue illustrate three aspects which should be addressed by therapists:

1) firstly, the need to try to help researchers by engaging with them and by informing families of the possibilities of participating in various trials - recruitment to trials is still a problem;
2) secondly, the need to formally assess, using validated measures if available, and to document such assessments of all children referred;
3) thirdly, the need to ensure that all treatments are based on scientifically gathered evidence and not on opinion, however well publicised.

Readers interested in our rare diseases section may also be interested the article by McCarthy et al (2011) on Lesch-Nyham disease in the UK, and the commentary ‘Needles in haystacks: the challenges of rare diseases’ Jinnah (2011).

Users of Botulinum toxin injections in their clinical practice may, in addition to our Cochrane review summary, like to read O’Flaherty et al (2011) on the ‘Adverse events and health status following Botulinum toxin type A infections in children with C.P.’ and the commentary by Narayanan (2011).

The journal will appear twice a year in April/May and in November/December for the present time. It will stand or fall by the number and quality of papers you, the readers, send us. At the back of this issue you will find information to assist you with preparing your work for submission. All submissions will be peer-reviewed.

Submissions should be emailed to the APCP Administrator at va@apcp.org.uk. Submissions for the next issue should be received by July 1st 2011.

We hope you enjoy this issue and the Editorial Board would value any feedback from members.

References


Lewis SD What was wrong with Tiny Tim? American Journal Disabled Child 1992. 146. 12. 1403-7


Introduction

Hemiplegia is a physical impairment that can occur in children, usually due to cerebral palsy. Children present with one sided weakness and impaired motor function. Unlike adults with hemiplegia, who have had function in their upper limbs prior to the central nervous system insult, children with congenital hemiplegia have never used the affected upper limb normally from birth.

Constraint induced movement therapy (CIMT) is an intervention which addresses this behavioural hypothesis of developmental non-use in children by focusing the child’s attention onto their affected hand during treatment as well as utilising the potential for central nervous system plasticity in young children (Charles 2005a). Early studies examined the effects of a technique called ‘forced use’ on the affected upper limb. This technique used an external restraint on the unaffected upper limb, which prevented the child from using it. No specific treatment programme was used and the child was ‘forced’ to use the affected upper limb during all activities (unstructured practice). Gradually the intervention was refined to include structured practice as well as restraint and was termed CIMT (Taub1999). The structured practice developed was a combination of shaping and repetitive practice. Shaping is a behavioural technique in which a motor activity is approached in small steps with the task being made more difficult over a period of time. In repetitive practice functional tasks are performed continuously over a specific period. Usually the structured practice period was 6 hours in duration and feedback about performance was given to the patient (Charles 2005a). Modifications to CIMT are currently being introduced to both the type and duration of restraint and the length of structured practice.

CIMT was derived from basic neuroscientific research with monkeys. In studies, a single forearm of a monkey was deafferented so that the animal was unable to use it. When a movement restriction

Abstract

Objectives: To develop and evaluate the effectiveness of a modified method of constraint induced movement therapy (CIMT) on hand function in young children with congenital hemiplegic cerebral palsy CP.

Background: Unlike previous CIMT studies where physical restraint of the unaffected arm used a splint or plaster cast, this study investigated the use of gentle restraint by an adult’s hand and verbal encouragement. Treatment was a structured programme of play activities one hour a day for 28 days.

Design: Multi-centre individually randomised parallel group design. Participants were randomly assigned to treatment and control groups using a minimisation method. Treatment effectiveness was evaluated using the Quality of Upper Extremity Skills Test, which provided information related to movement and postural responses and the Assisting Hand Assessment, which evaluated bi-manual hand function. The assessor was masked to the treatment groups and to avoid bias, statistical analysis was undertaken once all the data had been collected.

Participants: Forty-three children with congenital hemiplegic CP aged 18 months to 5 years from nine paediatric centres took part in the study.

Results: An independent samples test was carried out using the change scores following the intervention, which allowed for the imbalance in scores between the two groups. Analysis of the primary outcome measure gave a mean difference in change score of 5.50 (confidence interval; 4.31 to 6.69, p < 0.01).

Conclusion: Overall, the intervention tested in this trial improved upper limb function in a group of children with congenital hemiplegic cerebral palsy. Recent studies have shown that early intervention may optimise development of motor skill potential. If better function can be established early by incorporating this intervention into treatment, it may mean that children will need less intensive therapy when they are older.
that may occur. Recent evidence suggests that children with hemiplegic cerebral palsy may benefit from CIMT. Initially the method of restraint used for children was a plaster cast applied for 3-4 weeks (Taub 2004, Willis 2001, Yasukawa 1990), but recently, there have been a number of modifications made to this technique. Modifications have included a sling for six hours a day (Gordon 2006b), a glove for two hours a day (Eliasson 2005) and gentle restraint from a parent’s hand plus verbal encouragement for one hour a day (Naylor and Bower 2005).

In a pilot study (Naylor and Bower 2005), two modifications to conventional CIMT were made. These modifications were: a) constraining the child’s unaffected hand using a parent’s hand plus verbal encouragement rather than a plaster cast and b) using a structured programme of play activities for treatment to ensure that all children received the same fine motor programmes.

The first modification arose from a concern over immobilising a normal limb in plaster. CIMT is a uni-manular intervention, and as such, prevents the child from functioning bilaterally, but increased functional independence requires the use of both hands in co-operation (Gordon 2007). Immobilisation of the unaffected arm in a young child also raises concerns over safety. If a child is prevented from using their normally functioning arm, then there can be a risk of lack of protection on falling and balance reactions may be compromised. Immobilisation in plaster casts have been shown to lead to muscle atrophy and subsequent loss of function (Velhuizen 1993, Booth 1987). In a study of 12 young adults, one healthy forearm was immobilised for 21 days and results showed a reduction of maximum grip strength of 18%, grip endurance of 19% and a loss of muscle function of 18-45% (Kitahara 2003).

Method

Participants

Children were included in the trial if they had a diagnosis of congenital hemiplegic cerebral palsy, which had been made by a consultant paediatrician, were aged between 18 months and five years and were attending the participating centres for therapy. They were excluded from the trial if they had unilateral signs but did not have a diagnosis of congenital hemiplegic cerebral, were under 18 months or over five years or had bilateral involvement. Medical histories were extracted from their medical notes.
Study Design
The trial in this study was a randomised controlled trial with children assigned to treatment and control groups using a computer programme. It was a multi-centre individually randomised parallel group design. A multi-centre study design was chosen to allow for recruitment of children from both urban inner-city areas and rural areas and from different ethnic backgrounds. Children were involved in the trial for a period of 16 weeks. The children in the treatment group received the intervention between weeks 4 and 8. The control children received the intervention following the end of the trial between weeks 12 and 16. Figure 1 shows the trial time line.

Sample Size
A sample size calculation was carried out to determine the number of children needed in each group. This used 80% power to detect a clinically relevant difference of 10-point improvement in scores following treatment from the Quality of Upper Extremities Skills Test at a 5% significance level. The sample size was calculated from the standard deviation (4.6) and outcome range (4.8-17.08) found in the pilot study. The required sample size was two groups with 30 children in each. Although no one declined to participate in the pilot study, an allowance was made for families declining to take part and therefore it was aimed to approach 70 families in order to recruit 60 children.

Ethics Approval
As this was a multi-centre trial, an application was made via the central office for research ethics committees (COREC) to the London multi-regional research ethics committee (MREC). Subsequently as each centre was identified, a principal investigator was appointed at each centre. A site specific assessment and application to each of the relevant local research ethics committees (LRECs) was made and local research governance approval sought.

Randomisation
The children were assigned to two groups, using a minimisation technique with a random element, to ensure that the two groups were balanced. Minimisation is a way of assigning patients to treatment and control groups which minimise the differences between the groups both in number and in patient characteristics. This method ensures that any differences can be attributed to treatment effect and not factors such as age or severity of symptoms (Treasure1998, Pocock 1975, Taves 1974). For this trial the minimisation factors were age, severity of symptoms and learning difficulties. The severity of symptoms were evaluated using a modification of the Manual Ability Classification System (MACS) as the MACS is only validated for children over 4 (Ellison et al 2006) and a consultant paediatrician diagnosed learning difficulties.

Masking
To avoid bias and to ensure allocation concealment an independent researcher based at Queen Mary, University of London used a computer programme to determine the allocation. The individual centres were then notified whether the child was in the treatment or control group. The researcher who undertook the assessments of the participants was not involved in the treatment allocation process to ensure allocation concealment and masking of the assessor.

Intervention
The intervention followed a structured programme of fine motor and play activities aimed at improving the children's hand function. This intervention was developed in the pilot study to encourage optimal fine motor function. The children attended for two sessions a week with their own therapist. Each session started with warm up action songs and then the children participated in activities such as playing with dough, sorting, threading, posting boxes and jigsaws or form boards following a detailed programme of activities that included instructions on how each activity should be performed taking into account level of cognitive ability and severity of symptoms. The emphasis was on ensuring that all the children performed the same fine motor activities but at their own level, physically and cognitively. Parents were given a home programme for other days and advised that if they wanted to undertake the intervention in two half hour sessions to fit into their day, this was acceptable.

Outcome measures
Fine motor function was evaluated using the Quality of Upper Extremities Skills Test (QUEST) (DeMatteo et al 1993) as the primary outcome measure and the Assisting Hand Assessment (AHA) (Krumlinde-Sundholm et al 2003). The QUEST
provides information related to movement and postural responses and evaluation of upper limb function. It measures changes over time and is validated for children aged between 18 months and 8 years. The AHA is a validated test, which measures the effectiveness with which a child with unilateral impairment makes use of their affected hand in bimanual activity performance. It is a standardised criterion-referenced test for children aged between 18 months and 5 years. (Krumlinde-Sundholm 2005). Parents were given a questionnaire, which had been trialled in the pilot study to gain their perceptions of the intervention.

**Data Analysis**

The effectiveness of the intervention was found by analysing the data collected at the baseline assessment and at assessment 3 after the treatment group had received the intervention. The data was analysed using an independent samples ‘t’ test and analysis of covariance. Maintenance of the treatment effects was evaluated using the paired ‘t’ test to compare the data from assessment 3 and assessment 5. The data was analysed using SPSS version 14.
Results
Seventy-two children were identified as potential participants in 9 centres, of which 66 met the inclusion criteria. Of those 66, 21 did not agree to participate (reasons given were: too much commitment, no response to request to participate, moved away). A total of 45 families agreed to take part, although two withdrew after randomisation but before the trial started in their centre. Figure 2 shows a flow diagram of the phases of the trial.

Fifteen of the children were born prematurely and half of the total number of children had a difficult neonatal period. Nineteen of the children were born at term and had no problems in the neonatal period. A summary of the characteristics of the participants is presented in Table 1 with the minimisation variables shown. Table 2 shows the children’s medical history.

Outcome measures
All the children who entered the trial attended for at least one baseline assessment and 33 children attended both. Where children had two baseline scores the second score was used to allow for any potential training effect. Forty-two children attended for assessment 3, which was after the treatment group had received the intervention, one child dropped out of the study prior to assessment 3. When the data was analysed, a problem with the classification of severity of symptoms was identified. The mean scores for the children in the control group with mild and moderate symptoms were higher than those for the treatment group and in both groups and there was an overlap of scores between those with mild and moderate symptoms. When the change scores were studied, it was clear that the children in the treatment group had significant improvement in the outcome measures following the intervention whilst the control group showed no change. Consequently, the data analysis was carried out on the change scores and also using analysis of covariance with severity of symptoms as the fixed factor. Such analyses allow for discrepancies in the baseline scores. Analysis of the change score data following the intervention is shown in Table 3 and in Figures 3 and 4. The analysis of covariance is shown in Table 4.

Table 1: Characteristics of the participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Totals (percentage) n=43</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>22 (51%)</td>
</tr>
<tr>
<td>Female</td>
<td>21 (49%)</td>
</tr>
<tr>
<td>Right hemiplegia</td>
<td>23 (53%)</td>
</tr>
<tr>
<td>Left hemiplegia</td>
<td>20 (47%)</td>
</tr>
<tr>
<td>Mean age in months [range]</td>
<td>39 [18-68]</td>
</tr>
<tr>
<td>Mildly affected (modified MACS)</td>
<td>15 (35%)</td>
</tr>
<tr>
<td>Moderately affected (modified MACS)</td>
<td>20 (47%)</td>
</tr>
<tr>
<td>Severely affected (modified MACS)</td>
<td>8 (19%)</td>
</tr>
<tr>
<td>Learning difficulties</td>
<td>11 (26%)</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>4 (9%)</td>
</tr>
</tbody>
</table>

Table 2: Participant’s medical history

<table>
<thead>
<tr>
<th>Factor</th>
<th>Totals (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full term normal delivery</td>
<td>19 (43%)</td>
</tr>
<tr>
<td>Full term difficult birth</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Emergency LSCS – foetal distress</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Elective caesarean</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Premature &lt; 34/40</td>
<td>15 (35%)</td>
</tr>
<tr>
<td>Intra ventricular haemorrhage</td>
<td>12 (28%)</td>
</tr>
<tr>
<td>Middle cerebral artery infarct</td>
<td>6 (14%)</td>
</tr>
<tr>
<td>Hypoxic ischaemic encephalopathy</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Peri-ventricular leucomalacia</td>
<td>2 (5%)</td>
</tr>
<tr>
<td>Other pathology</td>
<td>12 (28%)</td>
</tr>
<tr>
<td>No aetiology found</td>
<td>4 (9%)</td>
</tr>
<tr>
<td>No investigations done</td>
<td>4 (9%)</td>
</tr>
<tr>
<td>Twin birth</td>
<td>4 (9%)</td>
</tr>
<tr>
<td>Neonatal fits</td>
<td>2 (5%)</td>
</tr>
<tr>
<td>Prenatal trauma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Neonatal infection</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Complications of neonatal surgery</td>
<td>1 (2%)</td>
</tr>
</tbody>
</table>
Table 3: Analysis of change score data – treatment group

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Test</th>
<th>Mean difference</th>
<th>Standard error</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
<th>Sig. 2-tailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUEST change</td>
<td>Independent samples 't' test</td>
<td>5.50</td>
<td>0.59</td>
<td>4.31</td>
<td>6.69</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>AHA change</td>
<td>Independent samples 't' test</td>
<td>1.25</td>
<td>0.13</td>
<td>0.98</td>
<td>1.51</td>
<td>p &lt; 0.01</td>
</tr>
</tbody>
</table>

Table 4: Analysis of covariance – treatment group

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Co-efficient</th>
<th>p value</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUEST</td>
<td>5.11</td>
<td>p &lt; 0.01</td>
<td>4.24</td>
<td>5.98</td>
</tr>
<tr>
<td>AHA</td>
<td>1.19</td>
<td>p &lt; 0.01</td>
<td>0.82</td>
<td>1.55</td>
</tr>
</tbody>
</table>

Figure 3: Median, inter-quartile ranges and extreme values for change in QUEST scores (changeQ) following the intervention

Figure 4: Median, inter-quartile ranges and extreme values for change in AHA scores (AHA Rasch change) following the intervention
Maintenance of treatment effect

Of the 22 children in the treatment group, three missed both follow-up assessments and a further three missed the final assessment. The reasons given for not attending the last assessments were: ‘forgot the appointment’ n=3, ‘illness’ n=2, ‘withdrawal from the study’ n=1. Of the remaining children, six maintained their intervention scores, seven had a slight decrease and three had slightly higher scores. The mean change score at follow up was 0.068. Table 5 shows the data analysis of maintenance of treatment effect.

Table 5: Analysis of maintenance of treatment effect – treatment group

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Test</th>
<th>Mean difference</th>
<th>Standard error</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
<th>Sig. 2-tailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment group maintenance scores – QUEST ‘t’ test</td>
<td>Paired ‘t’ test</td>
<td>0.068</td>
<td>0.13</td>
<td>-0.21</td>
<td>0.35</td>
<td>0.61</td>
</tr>
<tr>
<td>Treatment group maintenance scores – AHA ‘t’ test</td>
<td>Paired ‘t’ test</td>
<td>0.03</td>
<td>0.05</td>
<td>-0.08</td>
<td>0.14</td>
<td>0.61</td>
</tr>
</tbody>
</table>

Functional improvements were seen in all of the children following the intervention. However, the changes observed were different depending on the severity of the hemiplegia, this distribution of changes was observed in both groups. Table 6 shows the areas where the children changed and is taken from the items that are evaluated in the AHA which is the functional outcome measure. Table 7 presents the parents’ perceptions of the treatment and what affect it had had on their child’s hand. 31 questionnaires were returned which is a 72% return rate.

Table 6: Effects of treatment for the three severity groups

<table>
<thead>
<tr>
<th>Severity</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>Better fine motor adjustment, grasping, co-ordination and pace</td>
</tr>
<tr>
<td>Moderate</td>
<td>Better grasp and release, pace, co-ordination of two hands together and more spontaneous use of hand</td>
</tr>
<tr>
<td>Severe</td>
<td>Better initiation of movement and approach, and better general use of the arm</td>
</tr>
</tbody>
</table>

Table 7: Parental perception of the intervention

<table>
<thead>
<tr>
<th>Parent perceptions</th>
<th>Results (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed improvement in child’s fine motor skills</td>
<td>30/31 (97%)</td>
</tr>
<tr>
<td>Child more aware of their affected hand</td>
<td>31/31 (100%)</td>
</tr>
<tr>
<td>Improved concentration</td>
<td>28/31 (90%)</td>
</tr>
<tr>
<td>Child enjoyed the treatment sessions</td>
<td>30/31 (97%)</td>
</tr>
<tr>
<td>Parent’s enjoyed the treatment sessions</td>
<td>30/31 (97%)</td>
</tr>
<tr>
<td>Parents felt able to carry out the treatment at home</td>
<td>31/31 (100%)</td>
</tr>
<tr>
<td>Parents wanted to continue the treatment after the trial had ended</td>
<td>30/31 (97%)</td>
</tr>
</tbody>
</table>

Discussion

This trial evaluated the effects of a modified method of constraint induced movement therapy for young children with congenital hemiplegic cerebral palsy. Results from the trial for both outcome measures showed that the children’s hand function improved significantly following the intervention. Analysis of the maintenance of improvement in the treatment group showed very little change in the scores suggesting that the improvements had been maintained for up to eight weeks. The magnitude of effect from this trial was considered to be clinically useful and consistent with that specified from test/retest analysis of the AHA (Krumlinde-Sundholm 2005).
The potential for greater corticospinal tract plasticity in younger children suggests that implementing interventions earlier may have an effect on improving hand function in children with hemiplegia. It is clear that corticospinal tract connections continue to develop during the first few years of life and therefore it could be surmised that restriction of the unaffected upper limb of a child with hemiplegia could have a detrimental effect on the development of fine motor skills. It is therefore important that these factors are taken into account when planning an intervention such as CIMT with very young children and gives support to the development of modified methods of the technique which reduce the amount of time that young children remain in a restriction device. One problem, however, with implementing CIMT at a very early age is the level of adherence that can be achieved with very young children.

More often than not, it is the parents who are motivated to try new intensive techniques and problems occur when the children themselves are not able to adhere to a treatment programme for long periods. Therefore programmes which are less intensive and give periods each day for bilateral hand function may be more acceptable to young children and are important from a neuro-developmental perspective. As children get older, their motivation to improve their own function generally increases and they are more prepared to participate fully with an intensive treatment programme, in which case longer periods of restraint may be more effective.

The stage of motor development is likely to have important implications for the type of activity used in an intervention. Children with hemiplegic cerebral palsy demonstrate stereotypical patterns of movement resulting from the limited repertory of neuronal networks. Therefore, CIMT interventions for younger children may have to focus on motor development and primary skill acquisition aimed at enlarging primary neural networks through experience, whereas, interventions for older children should focus on fine motor and manipulation skills aimed at increasing practice of the upper limb (Hadders-Algra 2001).

Cognitive ability and behaviour are factors that must be considered when designing an intervention programme as they can affect how well the child understands what is asked of them and how well they can adhere to the intervention programme. It is vitally important that these factors are also taken into account in an intervention that is designed for parents to carry out at home. Parents need to feel that they have a programme that is adapted for their child and that it has the potential to be beneficial and worth undertaking.

Benefits of the trial
In this trial, no external restraint such as a splint or plaster cast was used, which made it easier for parents to administer and the methodology was devised as a result of concerns over safety when children wore restraints, potential problems with compliance with the restraint protocol and the possible side effects of prolonged upper limb casting. It is important when considering future research to be aware of the risks of muscle wasting due to immobilisation of the unaffected upper limb in a plaster cast and also the possible risk of developing joint stiffness and loss of range of movement. Whilst the wearing of a cast ensures that the restraint is controlled, there is a risk of frustration, particularly in younger children and a benefit of this modified method of CIMT is that it potentially reduces that frustration. Another benefit of modified methods of CIMT, which use shorter periods of restraint, is that they also allow the child to function bimanually for most of the day, which is important for development. As acquisition of movement is partially dependent on sensori-motor experience, it is important that the child is able to experience movement and sensori-motor feedback through both hands.

The results of this trial have implications for three different groups of people. Firstly, hemiplegic children for whom the intervention has been designed; secondly, the parents who have access to a treatment that they can administer themselves; and thirdly, the services who manage the children. It has been found that a burst of intensive treatment using this modified method of CIMT leads to an increase in hand function with maintained hand skills for eight weeks. By training the parents to carry out the method, children may need less treatment from a therapist in the longer term. This could have implications for the way in which therapy is undertaken. By reducing the amount of input given to each child and enabling therapists to see a greater number of children this could then have an impact on waiting lists. It also empowers parents in the management of their children.

Limitations of the trial
A limitation of the intervention is that the method of gentle restraint of the unaffected arm and the length of time that the child’s arm is being restrained is difficult to control when parents are carrying out the intervention at home. A second limitation is the
lower limit of the inclusion age. This is limited by both outcome measures only being validated from 18 months. In view of the evidence that early intervention is important for these children it would be beneficial to have included younger children in the trial.

Future Research
Overall, this method of gentle restraint with a structured programme of fine motor activities to improve fine motor function was found to be successful. However, the age range included in the trial was limited to children under six years of age. Determining whether the intervention may also be beneficial for older children using an age appropriate treatment programme is necessary to help establish whether there is a 'best age' for treatment and a 'best method' of CIMT. A future trial which compares the effects of different methods of restraint on different age groups of children could determine whether one method is better for one particular age group. This would need to be a large multi-centre study to give sufficient children for the trial. It should include children up to the age of 16 and compare the modification used in this trial with plaster casts and removable restraints.

Conclusion
The trends observed in this study are consistent with those seen in other CIMT studies with children and the positive quantitative results obtained from the QUEST and AHA scores are supported by subjective evidence from the parent questionnaire and feedback from the therapists. Recent studies have shown that early intervention may optimise development of motor skill potential. If better function can be established early by incorporating this intervention into the general scheme of care it may result in children needing less intensive therapy as they grow older.

The results of this study are sufficiently promising to justify further work to determine more precisely the effectiveness of this modified method of CIMT in comparison to other methods.

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To my PhD supervisors Professor Gene Feder and Professor Sandra Eldridge at Queen Mary, University of London for their research expertise and continual support and guidance during my PhD.
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A very special thank you must go to all the children and families who took part in the trial, without them; there would be no trial!

References


Pocock SJ, Simon R (1975) ‘Sequential treatment assignment with prognostic factors for the controlled clinical trial’ *Biometrics* vol. 31(1) PP.103-115


Introduction

NE in term infants remains a problem in relation to morbidity and mortality, in spite of continuing advances in neonatal care (Carli et al, 2004). The incidence has been reported as 1 to 2 per 1000 live term births (Volpe, 2001) but has been reported to be as high as 3.8 per 1000 live term births for the population in Western Australia (Badawi et al, 1998). In terms of the impact of morbidity in this group of children, there are few long-term studies looking at outcome at 5 years or more, but the importance of long term follow-up, particularly in the group with mild neonatal encephalopathy, has been highlighted. Barnett et al (2002) recommended continued surveillance of children with apparently normal outcomes at 2 years after NE to identify school-aged children with perceptual-motor difficulties such as developmental co-ordination disorder (DCD). Systematic long-term follow up is required to deal with problems of minor motor dysfunction and memory impairment (Carli et al, 2004) with continued individual follow up to identify need for early interventions and educational provisions (Dixon et al, 2002; Dilenge et al, 2001). This is important for paediatric physiotherapists who work as part of the multidisciplinary team in order to identify the functional abilities of children with disabilities and target intervention to improve daily living skills.

Functional Outcome of Children at Six Years after Neonatal Encephalopathy: a pilot study.

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Abstract

Objectives and Design: The aims of the pilot study were to confirm the incidence of Neonatal Encephalopathy (NE) in Antrim Hospital (AH), Northern Ireland, by establishing a methodology to determine retrospective identification of cases. The second strand was prospective recruitment of infants with NE, identified in the retrospective strand of the study, to identify their functional outcome at 6 years (using the Pediatric Evaluation of Disability Inventory [PEDI]) compared to controls; and if physiotherapy assessment was carried out in the neonatal period, did the findings correlate to the long-term outcome of this group of infants.

Results: The incidence of NE was 3.9/1000 live term births. The median PEDI score for the study group was below the expected mean value of 50 for self care and mobility, but although above 50 for social function, was still less than the control group. There was no difference between the groups for social function in relation to caregiver assistance. Not all infants had an initial standardised physiotherapy assessment so no conclusions can be drawn.

Conclusions: The study concluded that children with NE may not have a normal functional outcome at 6 years and recommended standardised, long-term follow up to detect disabilities which are not Cerebral Palsy (CP).
study, to identify their functional outcome at 6 years (using the PEDI) compared to controls; and if physiotherapy assessment was carried out in the neonatal period, did the findings correlate to long-term outcome.

This study was carried out before whole body hypothermia became the standard treatment for infants with moderate to severe encephalopathy (Jacobs et al, 2007).

Method

This was a quantitative research investigation using a case-control design to investigate infants diagnosed with NE in the Neonatal Unit, AH, Northern Ireland. Ethical approval was granted by the Office for Research Ethics Committees in Northern Ireland (ORECNI) before participants were recruited to the study. Research governance was granted by the Research and Development Committee in United Hospitals Trust, Northern Ireland.

Participants

Participants for the study group were identified from the neonatal unit admission book which had details recorded for all infants born between 1st April 2000 and 31st March 2001. All infants born at 37 weeks gestation or more were identified from this database. The diagnosis recorded by the nursing staff in the neonatal admission book was cross-referenced with the neonatal discharge letter, written by the paediatrician, using the hospital Northern Ireland Paediatric Patient Event Recording System (NIPPERs) to get the medical diagnosis. A diagnosis was recorded by the Researcher (AB) from NIPPERs for those who had none recorded in the admission book.

The inclusion and exclusion criteria can be found in Appendix 1. By using the chosen inclusion and exclusion criteria the study was confined to the group of infants with hypoxic ischaemic type of NE. This information was used to calculate the incidence of NE and to identify eligible participants for the prospective long-term follow up strand of the study.

The following data was collected, if available, for the infants included in the study group: sex; mode of delivery; gestational age; birth weight; Apgar scores at one and five minutes; cord pH and base excess. The maximum Sarnat score (Sarnat et al, 1976) and duration of stages of Sarnat score; the presence of seizures and the number of anticonvulsant drugs to control seizures was recorded as a measure of the severity of the encephalopathy. The number of days to full feeding and the length of the hospital stay were also collected as this indicated the measure of recovery from the encephalopathy.

If the infant was referred to the physiotherapist, the type of assessment was recorded, along with the need for ongoing physiotherapy input at six years. This was recorded taking details from both the medical and physiotherapy records. Medical records were reviewed blind to outcome at 6 years.

Prospective Participant Recruitment

In order to contact the family, a letter was sent to the child’s GP to confirm that the child lived at the address given and if there were any changes in circumstances that should be made known to the researcher, e.g. death, severe/acquired disability. This letter was signed by the Consultant Neonatologist, and an information leaflet outlining details of the proposed study, a reply slip and prepaid envelope were included. If the GP did not reply, the researcher (AB) followed this up with a telephone call. Each family was then contacted by letter, with an information leaflet outlining the study, two consent forms to be signed and returned if willing to take part, and a prepaid envelope. If the family did not reply to the first letter of invitation a second one was sent two weeks later. The infants were recruited into the study group if parental consent was given.

Selection of Controls

A convenience sample of ten children (two females and eight males) was recruited from willing staff in United Hospitals Trust. An information leaflet explaining the study was given to the parent(s) and a consent form was signed and returned to the researcher.

Follow-Up

Following recruitment of groups, the parents were contacted by telephone to arrange a suitable time, and venue, to complete the parental interview with the researcher. The functional outcome measure selected was the PEDI (Haley et al, 1992) which provided a comprehensive clinical assessment of key functional capabilities and performance of the children at age 6. The PEDI measures both capability and performance of functional abilities in three parts: self-care, mobility and social function. Functional capability is measured by the identification of functional skills the child has achieved and level of competence, and functional performance is measured by the level of care-giver assistance provided.
needed to accomplish major functional activities, for example, eating or walking outside. The PEDI has been standardised on a normative sample of children (USA), which enabled normative standard scores to be calculated from the raw data. A score of 50 is the expected mean standard score at each age interval and 95% of children in each age group are expected to score within 2 standard deviations of the mean (i.e. between 30 and 70). The scores were recorded in the booklet which also contained a summary score that was used to construct a profile of the child’s performance across the different domains and scales. In this study the PEDI was administered by structured interview with a parent(s) for both groups and an individual profile was generated. If any abnormal findings arose from the parental questionnaire the child was referred back to the Consultant Paediatrician, or the child’s GP, if not already known to services.

Results
From 1st April 2000 to 31st March 2001 there were 307 admissions to the Neonatal Unit, AH. Of these, 156 infants were born at term, with 9 infants having more than one admission to the Unit (i.e. having been transferred to another hospital and then back to AH), leaving a total of 147 infants. Of the 307 admissions to the neonatal unit 43 (14%) infants had no diagnosis recorded in the neonatal admission book. Twenty two (15%) of the term infants had no recorded diagnosis. Using the information from the neonatal admission book and NIPPERS the inclusion criteria were used to identify the study group. One hundred and eight infants were excluded at this stage of the study (Table 1), leaving 39 infants who fulfilled the initial criteria for enrolment into the study.

Further details were obtained from NIPPERS and this eliminated a further 18 infants from the study (Table 2).

Table 1: Exclusion criteria – primary diagnosis

<table>
<thead>
<tr>
<th>Exclusion criteria - primary diagnosis</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhesus incompatibility</td>
<td>4</td>
</tr>
<tr>
<td>Cardiac condition</td>
<td>4</td>
</tr>
<tr>
<td>Congenital abnormality</td>
<td>11</td>
</tr>
<tr>
<td>Respiratory</td>
<td>34</td>
</tr>
<tr>
<td>Hyperbilirubinaemia</td>
<td>19</td>
</tr>
<tr>
<td>Abdominal distension</td>
<td>2</td>
</tr>
<tr>
<td>Neonatal dehydration</td>
<td>1</td>
</tr>
<tr>
<td>Inborn errors of metabolism</td>
<td>7</td>
</tr>
<tr>
<td>Reflux</td>
<td>2</td>
</tr>
<tr>
<td>Scalp abscess</td>
<td>1</td>
</tr>
<tr>
<td>Sepsis</td>
<td>7</td>
</tr>
<tr>
<td>Intraventricular haemorrhage</td>
<td>1</td>
</tr>
<tr>
<td>Fracture</td>
<td>1</td>
</tr>
<tr>
<td>Intrauterine growth retardation</td>
<td>7</td>
</tr>
<tr>
<td>Neonatal meningitis</td>
<td>1</td>
</tr>
<tr>
<td>Anaemia</td>
<td>1</td>
</tr>
<tr>
<td>Death</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>108</strong></td>
</tr>
</tbody>
</table>

Table 2: Exclusion criteria – secondary diagnosis

<table>
<thead>
<tr>
<th>Exclusion criteria - secondary diagnosis</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac condition</td>
<td>3</td>
</tr>
<tr>
<td>Respiratory</td>
<td>9</td>
</tr>
<tr>
<td>Hyperbilirubinaemia</td>
<td>2</td>
</tr>
<tr>
<td>Reflux</td>
<td>1</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1</td>
</tr>
<tr>
<td>Intrauterine growth retardation</td>
<td>1</td>
</tr>
<tr>
<td>Anaemia</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

For the remaining 21 infants, only 5 had a medical chart that was still active, 15 sets of notes had been microfilmed and one chart could not be traced and had not been microfilmed. A study proforma was completed for each of the 21 infants and then the available medical charts and microfilmed notes were further trawled to obtain the final numbers for the study group. Thirteen infants were excluded at this stage for the following reasons (Figure 1); Apgar scores were not low at 1 and/or 5 minutes; absence of seizures; no recorded abnormality of tone. This left eight eligible infants. Of these eight only five families (62%) gave consent to take part in the study (three families responded to the first letter, and two to the follow up letter).

Figure 1: Flowchart to show recruitment into study
Full clinical data was not available for all the study infants and was not recorded in standard format. The clinical perinatal course of the study group is detailed in Table 3. The study group comprised one female and four males. Median gestational age was 39+4 weeks (range 38 to 42+2) for a median birth weight of 3860g (range 3317 to 4990). Four infants were born by normal delivery and one by vacuum. Apgar score was ≤ 5 at one minute in 3 infants. Base excess and cord pH were not recorded in any of the five charts. Three of the infants had severe NE, based on a broad definition as previously reported (Badawi et al, 1998). Four infants presented with seizures and abnormal tone, and three required two drugs to control seizures. Days to full feeding was recorded in one case. The median hospital stay was 8 days (range 6-17).

### Table 3: Perinatal data and outcome of study infants

<table>
<thead>
<tr>
<th>Infant</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>5</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis</td>
<td>HIE</td>
<td>Seizures</td>
<td>HIE</td>
<td>NE</td>
<td>Asphyxia</td>
</tr>
<tr>
<td>Sex</td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Gestational age</td>
<td>38</td>
<td>41</td>
<td>42+2</td>
<td>39+4</td>
<td>39</td>
</tr>
<tr>
<td>Birth weight (g)</td>
<td>3317</td>
<td>4425</td>
<td>3860</td>
<td>3460</td>
<td>4990</td>
</tr>
<tr>
<td>Mode of delivery</td>
<td>Vacuum</td>
<td>NVD</td>
<td>NVD</td>
<td>NVD</td>
<td>NVD</td>
</tr>
<tr>
<td>Inborn/outborn</td>
<td>O/B</td>
<td>I/B</td>
<td>O/B</td>
<td>O/B</td>
<td>O/B</td>
</tr>
<tr>
<td>Apgar score at 1min/5 min</td>
<td>7/8</td>
<td>4/9</td>
<td>5/7</td>
<td>8/9</td>
<td>1/3</td>
</tr>
<tr>
<td>Cord pH</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
</tr>
<tr>
<td>Base excess</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
</tr>
<tr>
<td>Maximum Sarnat score</td>
<td>N/R</td>
<td>N/R</td>
<td>2</td>
<td>N/R</td>
<td>N/R</td>
</tr>
<tr>
<td>Duration of stages of Sarnat score</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
</tr>
<tr>
<td>Seizures</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Number of anticonvulsants</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Duration of seizures (days)</td>
<td>8</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Days to full feeds</td>
<td>N/R</td>
<td>N/R</td>
<td>12</td>
<td>N/R</td>
<td>N/R</td>
</tr>
<tr>
<td>Length of hospital stay (days)</td>
<td>12</td>
<td>8</td>
<td>17</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Cranial ultrasound scan</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Other imaging – MRI, CT</td>
<td>CT</td>
<td>No</td>
<td>CT</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Physiotherapy (PT) assessment</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Assessment type /name</td>
<td>N/A</td>
<td>Neuro</td>
<td>Neuro</td>
<td>Neuro</td>
<td>N/A</td>
</tr>
<tr>
<td>Onward referral to community PT</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Reason for referral</td>
<td>N/A</td>
<td>Tone</td>
<td>Tone</td>
<td>Tone</td>
<td>N/A</td>
</tr>
<tr>
<td>Uptake of services offered</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Developmental outcome at 1 year</td>
<td>N/R</td>
<td>CP</td>
<td>CP</td>
<td>N/R</td>
<td>N/R</td>
</tr>
<tr>
<td>Requiring PT at 6 years</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Outcome at 6 years</td>
<td>DCD</td>
<td>CP</td>
<td>CP</td>
<td>Normal</td>
<td>Normal</td>
</tr>
</tbody>
</table>

HIE - hypoxic ischaemic encephalopathy; NVD - normal vaginal delivery; O/B - out born; I/B - in born; N/R - not recorded; N/A - not applicable; CP - Cerebral Palsy; DCD - Developmental Co-ordination Disorder

**Incidence**

The incidence of NE was 3.9 per 1000 term live births in AH which was higher than reported in other studies.

**Physiotherapy assessment**

Three of the infants had a physiotherapy assessment in the neonatal unit as they presented with abnormalities of tone and/or asymmetry of posture. A recognised assessment tool was not used. Onward referral to community physiotherapy services was made in all three cases. Two of the children with severe NE had cerebral palsy (hemiplegia and diplegia). The third was receiving occupational and speech and language therapy, and had been referred to the physiotherapy service for assessment. The other two children were not in receipt of any services.
All five children attended mainstream school. At age six three children were requiring physiotherapy services.

**PEDI**

The parental interviews for the study group were completed at a median age of 74 months (range 73-79) and an individual profile was generated for each child. The control group interviews were completed at a median age of 75 months (range 72-78). The median values and ranges for the PEDI domains can be found in Table 4.

The study group scored below the expected mean of 50 at each age interval in relation to self care (median 25.7 with a range of 18.3-34.4) and mobility (median <10 with a range of <10-54.9). The normative standard data score for social function was less for the study group (median 25.7 with a range of 18.3-34.4) and mobility (median <10 with a range of <10-54.9). The normative standard data score for social function was less for the study group (median 54.3 with a range of 21.9-63.2) than the control group (median 63.2 with a range of 34.6-67.8) but was above the expected mean score (Figure 2).

<table>
<thead>
<tr>
<th>Domain</th>
<th>Study group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=5</td>
<td>n=10</td>
</tr>
<tr>
<td><strong>Functional skills</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self care</td>
<td>25.7 (18.3-34.4)</td>
<td>39.6 (28.7-60.5)</td>
</tr>
<tr>
<td>Mobility</td>
<td>&lt;10 (&lt;10-54.9)</td>
<td>54.9 (53.9-54.9)</td>
</tr>
<tr>
<td>Social function</td>
<td>54.3 (21.9-63.2)</td>
<td>63.2 (34.6-67.8)</td>
</tr>
<tr>
<td><strong>Caregiver assistance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self care</td>
<td>31.3 (25.1-54.9)</td>
<td>61.6 (42.8-64.6)</td>
</tr>
<tr>
<td>Mobility</td>
<td>27.7 (17.3-53.8)</td>
<td>53.8 (52.7-59.2)</td>
</tr>
<tr>
<td>Social function</td>
<td>65.7 (23.3-65.7)</td>
<td>65.7 (47.5-66.3)</td>
</tr>
</tbody>
</table>

The study group required more caregiver assistance for self care (median 31.3 with a range of 25.1-54.9) and mobility (median 27.7 with a range of 17.3-53.8) than the control group, but there was no difference between the groups for social function (Figure 3).

**Discussion**

The incidence of NE in the current study was 3.9/1000 live term births using a widely accepted definition to allow comparisons to be made with other studies (Badawi et al, 1998; Larkin, 1997). The definition was broad and so allowed severe, moderate and mild cases to be identified. The incidence in the current study compares with the Western Australian study (Badawi et al, 1998) using similar inclusion criteria, but is higher than other reports (Pierrat et al, 2005; Larkin, 1997). This may be explained in part by the lack of information available in order to calculate the incidence in this study. The information on the total number of births in the catchment population was not available as AH is the referral centre for high risk pregnancies, so the incidence was calculated using the number of births from AH only, which may have given an artificially high incidence rate.

In this study a proforma was developed to record a range of neonatal variables for each infant but data was not recorded in a standard format in the medical notes and some baseline data was missing. Cord pH and base deficit, commonly measured perinatal variables, were not documented in any cases. Although the best definition of encephalopathy is the three categories described by Sarnat and Sarnat (1976) this was only recorded for one infant in this study. The literature is consistent in reporting that infants with Stage 1 have a good outcome and those with Stage 3 a poor outcome, with death or survival with disability almost 100% (Carli et al, 2004). Further missing data included the
number of days to establish full feeds, which would indicate the degree of recovery from the NE. This study found, like others, that seizures were the most important sign of an acute NE (Clancy, 2006) and infants who required 2 or more anticonvulsants drugs, and therefore had severe NE, had a worse outcome (Dix et al, 2002).

This study found that one child at age 6 had DCD which had not been detected during the short follow-up period before discharge from the paediatric service. This is important as poor motor skills can be associated with poor attention, low self esteem and anxiety (Barnett et al, 2002). Many children with NE have a short period of follow-up and face discharge if neurodevelopmental tests at 1 year or 18 months are normal (Barnett et al, 2004) and little attention has been given to quality of outcome in term infants with NE who do not develop CP. Barnett et al (2002) looked at a group of children with NE at age 8 and found that those with minor neurological dysfunction and perceptual motor difficulties, e.g. DCD, represented 23.5% of those without CP.

No conclusion can be reached from this study in relation to physiotherapy findings in NICU and correlation with outcome at 6 years, as not all infants received PT assessment, the numbers in the study were small and a validated assessment tool was not used. Only the study by Carli et al (2004) reported assessment by a physiotherapist, and this was at 12 months. Abnormal neurological examination in the neonatal period is reported as a good predictor of poor prognosis, especially if this persists Prechtl (1997). Early prediction of neurodevelopmental outcome after NE would allow parents to be counselled regarding outcome (Volpe, 2001) whilst allowing therapy services to be targeted at those at risk of developing functional deficits (Dilenge et al, 2001).

The PEDI results in this pilot study showed that children with CP or DCD in the NE group had lower scores in the self-care and mobility domains, and required greater caregiver assistance, than a group of peers. The children identified as normal showed similar results to the control group. This is an important finding as functional outcome is not well reported in the literature and the PEDI was not used in any of the previous NE outcome studies. A major advantage of using the PEDI is that it allows identification of the child’s strengths and weaknesses, providing information for treatment planning. It can be used as an outcome measure after therapy and gives parents a better insight to the child’s problems due to parental involvement. Functional assessment is described as ‘an effort to systematically describe and measure a child’s abilities and limitations when performing the activities of daily living’ (McCabe et al, 1990) which is closely related to the level of motor skills required at school. As there has been increasing attention paid to children at school age with DCD it is essential that children who are apparently normal at 2 years are followed up to allow early identification and intervention (Barnett et al, 2002). Failure to identify motor problems at an early age means the child will miss out on early intervention which may help them to cope at school and at home (Barnett et al, 2004).

The strength of this study is that it looked specifically at functional outcome six years after NE, an area that had been highlighted as needing further work (Dilenge et al, 2001). The limitations of the study were that there were small numbers in the study group, perhaps as parents had not been aware they would be contacted 6 years after a neonatal event. Also, not all the infants had a physiotherapy assessment in NICU so correlation of the early findings and those at 6 years could not be done. A future study should include physiotherapy assessment using a recognised tool, to allow early identification of neurological problems, to see if these findings correlate with functional outcome at 6 years. Recent evidence from eight randomised control trials included in a systematic review (n=638) has shown that therapeutic hypothermia is beneficial to term infants with hypoxic ischaemic encephalopathy (Jacobs et al, 2007) and that the benefits of cooling on survival and neurodevelopment outweigh the short-term adverse effects. As cooling has been shown to decrease mortality without increasing major neurodevelopmental disability in survivors it would be interesting in a future study to compare outcomes for infants with NE (moderate to severe) who have been cooled as this is no longer an experimental treatment. In the TOBY Study (Azzopardi et al, 2008) infants were assessed at 18 months of age using neurological and neurodevelopmental testing methods to demonstrate the reduction in the relative risk of mortality or serious disability following total body cooling for 72 hours.

Conclusions
In conclusion, this small pilot study has shown that infants with severe NE may not have a normal functional outcome at six years, even if they do not
develop CP. All infants who present with Sarnat stage 2 and 3 should be followed up until school age, with a standardised perinatal dataset to allow better population data collection (Marlow et al, 2005). Neurodevelopmental assessment should be carried out in the neonatal period and on an ongoing basis, with standardised long term follow-up to look at outcomes other than CP. The PEDI can be administered by structured interview and parental report, and as each PEDI scale is self-contained it can be used separately or together with other scales, in a maximum of one hour. It should be administered by professionals who have experience in childhood disabilities and costly training is not required. This is of major importance for all members of the multidisciplinary team as examination at 2 years did not pick up functional problems in a child who did not have CP. Additional information on the level of disability such as visual impairment, deafness and cognitive impairment (Marlow et al, 2005; Perlman, 2006) is also important when looking at outcome and future work needs to quantify the extent of the problem.

Acknowledgements
A very big thank you must go to the parents of the children who gave up their time to take part in the study. Thanks must also go to the R&D Office for providing financial support to allow completion of the Masters in Clinical Research at the University of Ulster and this study.

References


Appendix 1

To be included in the study all the following criteria had to be met:

- full term neonates (37 weeks or more);
- inborn/outborn and admitted to Neonatal Intensive Care Unit (Antrim);
- low Apgars (at 1 and/or 5 minutes);
- perinatal hypoxia/ischaemia;
- seizures and/or abnormal neurological behaviour compatible with neonatal encephalopathy.

For the purpose of this study the definition of neonatal encephalopathy was agreed as:

- alteration in consciousness (stupor or coma);
- altered responsiveness to stimuli such as normal handling during nursing procedures (increased or decreased) for greater than 24 hours;
- increased or decreased muscle tone;
- inability to feed orally for a period of greater than 24 hours;
- the presence of seizures of any type or duration.

All of the above factors did not have to be present to confirm the diagnosis.

Infants were excluded from the study if they had:

- low Apgars and/or fits not considered to be due to neonatal encephalopathy (such as hypoglycaemia, infection);
- neonatal meningitis;
- chromosomal abnormality;
- congenital malformations of brain;
- inborn errors of metabolism.
A Systematic Review
Do Strengthening exercises improve function in patients with cerebral palsy?

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Abstract

Background and purpose: Strengthening exercises have been considered an effective physiotherapy intervention for patients with Cerebral Palsy (CP) (Eagleton et al, 2004; Morton et al, 2005; Taylor et al, 2004a). However research is inconclusive on the benefits of strengthening exercises for functional gains in this population (Anttila et al, 2008; Darrah et al, 1997; Dodd et al, 2002; Scianni et al, 2009; Verschuren et al, 2008). Therefore this systematic review of randomised control trials (RCTs) will aim to address the contradictory evidence base.

Methods: Literature searches were performed to find relevant articles that explored functional gains for patients with CP, following strengthening interventions. The results of the searches were subjected to pre-specified inclusion and exclusion criteria, with studies eliminated if deemed ineligible. The seven remaining studies (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem and Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007) were reviewed using the Van Tulder checklist, PEDro scale and Cochrane Risk of Bias tool to extract data for further analysis.

Results of findings: Both statistically significant (p<0.05) and non-significant (p>0.05) results were found across the functional outcome measures. However this review did expose non-significant results in gait parameters across studies, with only one exception. Data analysis highlighted common methodological limitations and potential bias in the following areas: sample characteristics, allocation concealment, blinding, intention-to-treat analysis, the appropriateness of statistical tests and the sensitivity of certain outcome measures; in particular the Gross Motor Function Measure (GMFM), as it was widely used across studies.

Discussion: The studies reviewed support the growing body of evidence for the use of strengthening exercises for functional gains in patients with CP. However the methodological limitations and potential bias across studies affects the strength of the studies’ results.

Conclusion: Strengthening exercises, in a variety of settings and forms, can improve functional activities for patients with CP. However this review proposes that more research is necessary to further strengthen the evidence and add clarity to this area of physiotherapy practice. RCTs with sound methodological protocols should be employed, including measures of compliance and participants’ perceptions of functional ability.

Introduction

Cerebral Palsy (CP) describes a group of chronic developmental disorders that occur in the developing foetal or infant brain (Bax et al, 2005). This non-progressive condition is characterised by deficits in movement and postural control (Bax et al, 2005). The common impairments of muscle weakness and spasticity can contribute to deficits in functional activities such as ambulation and stair climbing (Shepherd, 1995). Patients with CP often experience a regression in their functional abilities during the transition from adolescence to young adulthood (Krakovsky et al, 2007). In light of this, primary goals of physiotherapy interventions target improvements in functional abilities (Shepherd, 1995).

Strengthening exercises have been considered an effective physiotherapy intervention for functional gains in patients with CP (Eagleton et al, 2004; Morton et al, 2005; Taylor et al, 2004a). While this review recognises that strengthening exercises are unlikely to be used in isolation, in order to meet the need for physiotherapy evidence based practice, their effectiveness needs to be explored (Bithell, 2000; Schreiber et al, 2009). Existing research investigating the effects of strengthening interventions for patients with CP has found both positive functional gains and potential negative outcomes, such as increases in spasticity. This has resulted in conflicting ideas for their use within the physiotherapy management of patients with CP.
Historically the Bobath approach advised against strengthening exercises as it was suggested their use could increase spasticity (Fowler et al, 2001). However a number of studies evaluating the effectiveness of exercise in CP have reported no such adverse effects on movement patterns or spasticity (Damiano et al, 1995; Fowler et al, 2001; Holland & Steaward, 1990; Lee et al, 2008). Several uncontrolled trials evaluating strengthening and resistance training programmes have documented improvements in strength, with additional gains in functional activities (Blundell et al, 2003; Damiano & Abel, 1998; Eagleton et al, 2004; Eek et al, 2008; MacPhail & Kramer, 1995; Taylor et al, 2004a).

Although, contrary to this, other studies found no functional benefits from strengthening programmes (Mcnee et al, 2009; Scianni et al, 2009).

Strength training programmes have been analysed by previous systematic reviews; the majority of which reported strength increases, but failed to examine randomised controlled trials (RCTs) (Anttila et al, 2008; Darrah et al, 1997; Dodd et al, 2002; Verschuren et al, 2008). The recent review by Scianni et al., (2009) did look exclusively at RCTs and concluded that strength training does not improve the strength and function in children and adolescents with CP. However three of the six RCTs reviewed by Scianni et al., (2009) employed co-interventions, such as electrical stimulation in conjunction with strength training programmes, or did not use functional outcome measures. Therefore these results do not solely represent the potential functional improvements from a strengthening exercise programme. This provides the scope for this review to determine whether or not strengthening exercises alone can improve function in patients with CP.

This systematic review of RCTs will aim to address the identified gap in the evidence base for patients with CP. RCTs comparing strengthening exercise programmes to conventional physiotherapy, measured with functional outcomes, will be reviewed. Their findings will be analysed and interpreted to propose recommendations for future practice.

**Method**

A pre-specified protocol for literature searches, eligibility criteria and data analysis was outlined before the onset of this review and stringently adhered to throughout.

**Data Sources and Searches**

The databases searched were: Biomed Central Journal, CINAHL (EBSCO), Cochrane library, Psych Info (EBSCO), PubMed, SwetsWise, Academic Search Complete (EBSCO), SPORTDiscus (EBSCO), Web of science (ISI) and Science direct (Elsevier). Only papers available electronically were accessed via the University of East London’s electronic database. The reference lists of studies found were then scanned for additional papers of interest. Searches were completed between 9th November 2009 and 5th December 2009.

**Search Protocol**

The following terms were searched: cerebral palsy, strengthening, improving function, exercises, post operative function, randomised control trial, randomised controlled trial, randomized control trial, randomized controlled trial, task oriented training. Literature searches were completed at a computer lab at The University of East London. Once a search was complete the entire search was printed for hard copy analysis. Two researchers then examined the article titles to filter out duplicates.

**Study Selection - Eligibility Criteria**

This systematic review will use the following headings: Population, Intervention, Comparator, Outcomes and Study Design (the PICOS format) to structure the eligibility criteria (The Cochrane Collaboration, 2009).

**Figure 1.**

Eligibility criteria with rationale for inclusions and exclusions made, structured in the PICOS format.

**Inclusion Criteria**

- **Participants:** Any age and gender, any Gross Motor Function Classification System level and CP diagnosis to address the population in question.
- **Interventions:** Strengthening exercises to determine their efficacy alone in improving function.
- **Comparator:** Conventional Physiotherapy to maintain consistency across control groups
- **Outcome measures:** Include one or more functional outcome measure, as this review is focusing on functional gains.
- **Study design:** RCT to review the best quality research, any date to ensure all relevant research is included and written in English as first language of the review.

**Exclusion Criteria**

- **Participants:** Co-morbidities to determine the effects of strengthening exercises on patients with CP
- **Interventions:** Co-interventions (Surgery or Botulinum toxin within the last 6 months and whole body vibration training) to determine the efficacy of strengthening exercises as a lone intervention.
- **Comparator:** Co-interventions (as above) to maintain consistency across control groups.
- **Outcome measures:** Do not include a functional outcome measure as this review is focusing on functional gains.
- **Study design:** Non RCT as they are not considered the best method for evaluating therapeutic interventions. Studies not written in English/American English due to language constraints of the reviewers.

**Study selection protocol**

The four researchers screened the results of the literature searches against the pre-specified eligibility criteria, based on title, abstract and finally full texts.
Data Extraction and Quality Assessment

To optimise the quality of data extraction, two preliminary attempts were made using the chosen critiquing frameworks. Data was independently extracted from the seven studies using the critiquing frameworks (the Van Tulder Checklist (Van Tulder et al, 2003) and the PEDro Scale (Physiotherapy Evidence Database, 2010). Agreement was reached through group discussion, after clarification was sought by email correspondence from PEDro (PEDro, 2010) and one study author (Dodd, 2010).

The Van Tulder checklist is described as a more appropriate tool than the Jadad scale for analysing physiotherapy research, it also provides a more in-depth analysis of a study’s methodology than both the Delphi and Bizzini scales (Olivio et al, 2008). Utilisation of the PEDro scale to analyse RCTs has been assessed for both validity (De Norton, 2009) and reliability (Maher et al, 2003). Furthermore Bhogal et al., (2005) ascertained that the PEDro scale provided a more comprehensive assessment of a paper’s methodological quality than the Jadad scale.

Risk of Bias

The possible risk of bias was assessed using the Cochrane Risk of Bias Tool (O’Connor et al, 2009), as suggested by the PRISMA guidelines (Liberati et al, 2009).

Data Items

Based on the critiquing frameworks and risk of bias tool the following information was extracted from each study: sample size, compliance, experimental and control intervention, outcome measures, follow up, study design, statistical analysis methods, randomisation, sequence generation, allocation concealment, baseline similarities, blinding, intention to treat analysis and incomplete outcome data.

Data Synthesis and Analysis

A meta-analysis is only applicable if the intervention or participants are similar across the studies being reviewed (Green, 2005; Liberati et al, 2009). However the participant and study characteristics within this review vary too significantly to be synthesised. Therefore a meta-analysis was not appropriate in this case. Other limitations of this review’s methodology will be addressed in the discussion.

Results

Study Selection Protocol

The searches produced 844 titles, after the removal of duplicates 524 titles were then screened by hand by all four researchers based on the inclusion / exclusion criteria (Figure 2). Titles not written in English (n=1) or not including ‘cerebral palsy’ or ‘spastic diplegia’ (n=437) were removed. Following this the remaining 86 abstracts were sought electronically and analysed for eligibility. At this stage a further 71 articles were eliminated for having co-interventions (n=2), no strengthening exercise program (n=64), no functional outcome measures (n=1), being a single case design (n=1) or no published results (n=3). The remaining 15 full texts were accessed and their reference lists scanned to identify any outstanding articles not previously found. This yielded an additional 3 studies which, following the same process of elimination, matched the inclusion criteria at this stage (n=18). The 18 full texts were then reviewed by the four researchers. A further 11 studies were excluded for not being a RCT design (n=9) and the inclusion of participants within six months of surgery (n=2). This resulted in seven RCTs for review (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007).

Figure 2. Flow diagram of study selection
Table 1: Summary of studies reviewed

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Design</th>
<th>Sackett</th>
<th>Participants</th>
<th>Sample size calculation</th>
<th>Compliance reporting</th>
<th>Long Term Follow up</th>
<th>Statistical Analysis tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dodd et al (2003)</td>
<td>RCT 1b</td>
<td>n=21 (11 F, 10 M)</td>
<td>Age= 13.1 (SD 3.1)</td>
<td>CP= spastic diplegia, GMFCS level I, II, III, IV</td>
<td>Yes</td>
<td>Yes:18 weeks</td>
<td>Appropriate; insufficient data</td>
</tr>
<tr>
<td>Engsberg et al (2006)</td>
<td>RCT 2b</td>
<td>n= 12 (9 F, 3 M), Age= 9.9 (3.52)</td>
<td>CP= spastic diplegia, GMFCS level I, II, III, IV</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Inappropriate; insufficient data</td>
</tr>
<tr>
<td>Liao et al (2007)</td>
<td>RCT 1b</td>
<td>n= 20 (8 F, 12 M), Age= 7.4</td>
<td>CP= spastic diplegia, GMFCS level I, II, III, IV</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Appropriate; sufficient data</td>
</tr>
<tr>
<td>Seniorou et al (2007)</td>
<td>RCT 1b</td>
<td>n= 20 (10 F, 10 M), Age= 12.5</td>
<td>CP= spastic diplegia, GMFCS level I, II, III, IV</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Unclear; insufficient data</td>
</tr>
<tr>
<td>Unger et al (2006)</td>
<td>RCT 1b</td>
<td>n= 31 (12 F, 19 M), Age= 13.5-18.92</td>
<td>CP= 14 diplegia, 16 hemiplegia, 1 triplegia spastic CP</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Appropriate; insufficient data</td>
</tr>
<tr>
<td>Verschuren et al (2007)</td>
<td>RCT 1b</td>
<td>n= 68 (24 F, 44 M), Age= 7-18</td>
<td>CP= spastic CP, GMFCS level I, II, III, IV</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Appropriate; insufficient data</td>
</tr>
</tbody>
</table>

RCT= randomised controlled trial, n= number of participants, F= females, M= males, SD= standard deviation, CP= cerebral palsy, GMFCS= Gross Motor Function Classification System.

Table 2: Summary of study interventions and outcomes

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Type of Intervention</th>
<th>Outcome measures</th>
<th>Difference between groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dodd et al (2003)</td>
<td>Exp= 6 week home-based strength training, 3 sets of 8-10 reps, 3 x per week, unsupervised in patients' home. Con= routine PT. Intervention briefly described.</td>
<td>GMFM, self selected walking speed, Timed Stair Test, PF, knee E+ hip E strength with hand held dynamometer</td>
<td>Strength p&lt;0.05, GMFM, Timed Stair Test + walking speed p&gt;0.05</td>
</tr>
<tr>
<td>Engsberg et al (2006)</td>
<td>Exp= 12 week PRE programme of PF, DF or PF+DF with isokinetic dynamometer &gt; 80% 1 RM, 3 x per week, supervised in patients' home by study T. Con= no intervention. Intervention briefly described.</td>
<td>GMFM, gait speed, knee E strength, Peds QL, end range DF</td>
<td>GMFM, strength, GMFM, Peds QL, gait analysis, end range DF</td>
</tr>
<tr>
<td>Liao et al (2007)</td>
<td>Exp= 6 week home based loaded STS, 10 x 20% 1RM, 50% 1RM repeated until fatigued, 3 x per day, 3 x per week, supervised in patients' home by caregiver. Con= routine PT. Intervention briefly described.</td>
<td>GMFM, gait speed, knee E strength, 1RM STS, PCI</td>
<td>GMFM, 1RM STS, PCI p&lt;0.05, Gait speed, knee E strength p&gt;0.05</td>
</tr>
<tr>
<td>Salem &amp; Godwin (2009)</td>
<td>Exp= 5 week task orientated strengthening exercises + functional task practice, 2 x week, supervised by same T, setting not described. Con= routine PT. Intervention briefly described.</td>
<td>GMFM, TUG</td>
<td>GMFM + TUG p&lt;0.05</td>
</tr>
<tr>
<td>Seniorou et al (2007)</td>
<td>Exp= 6 week PRE with free weights 10RM, 3x10 each muscle group, 3x week. Con= 6 week active exercise programme against gravity only, 3x week. Supervised in patients' home by study T. Both groups continued routine PT. Intervention briefly described.</td>
<td>GMFM, muscle strength with hand held dynamometer, 3D gait analysis</td>
<td>Muscle strength, GMFM + normalised walking speed p&lt;0.05 both groups. Gait kinematics + hip E strength p&lt;0.05</td>
</tr>
<tr>
<td>Unger et al (2006)</td>
<td>Exp= 8 week strength training circuit 8-12 exercises, 1-3 x week 40-60mins, supervised in school by research assistant. Con= no intervention. Intervention briefly described.</td>
<td>3D Gait analysis, Self perception questionnaire</td>
<td>Crouch gait + Body image perception p&lt;0.05, Gait velocity, cadence + stride length p&gt;0.05</td>
</tr>
<tr>
<td>Verschuren et al (2007)</td>
<td>Exp= 6 month functional group exercise circuit 2 x per week, continue regular therapy, supervised in school by paediatric T. Con= routine PT. Intervention briefly described.</td>
<td>10m shuttle run, muscle power sprint test, agility, muscle strength 30 sec RM, GMFM, HRQoL, CAPE and self perception profile for children.</td>
<td>10m shuttle run, muscle power sprint test, agility, muscle strength, + CAPE p&lt;0.05. GMFM, HRQoL + self perception profile p&gt;0.05</td>
</tr>
</tbody>
</table>

GMFM= Gross Motor Function Measure, reps= repetitions, TUG= timed up and go, Peds QL= paediatric quality of life, HRQoL= health related quality of life, CAPE= Children's Assessment of Participation and Enjoyment, PCI= physiological cost index, 3D= three dimensional, Exp= experimental group, Con= control group, DF= dorsiflexors, PF= plantarflexors, F= flexors, E= extensors, PRE= progressive resistance exercise, PT= physiotherapy, T= therapist, RM= repetition maximum, STS= sit to stand, p= p value.
Population
Male and female participants with varying classifications of spastic CP (Table 1) were recruited across a wide age range (5-18 years) and level of disability (Gross Motor Function Classification System (GMFCS) Level I, II and III). Sample sizes ranged from n=10 to n=68. Power calculations of sample size however were only documented by three studies (Dodd et al, 2003; Liao et al, 2007; Verschuren et al, 2007). Participant compliance was only discussed by two studies (Liao et al, 2007; Verschuren et al, 2007) which detailed good compliance to the exercise regimes but one failed to comment on compliance for the control group (Liao et al, 2007).

Interventions
Study intervention duration ranged from five weeks to eight months and frequency varied from once to thrice weekly (Table 2). The authors described the experimental intervention as a strength training exercise programme (Dodd et al, 2003; Engsberg et al, 2006; Unger et al, 2006), a progressive resistance training programme (Seniorou et al, 2007) or a task-oriented or task specific training approach (Liao et al, 2007; Salem & Godwin, 2009; Verschuren et al, 2007). Although there is variation in the labelling of interventions, strengthening exercises were the focus of all studies. The experimental interventions were delivered in various settings.

Six studies briefly described their exercise interventions (Dodd et al, 2003; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007). However Engsberg et al., (2006) were the only authors to document the experimental group’s intervention to a level of repeatability.

Comparator
Five studies administered routine physiotherapy treatment to the control group (Table 2), but this lacked uniformity within and across studies (Dodd et al, 2003; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Verschuren et al, 2007). Seniorou et al., (2007) administered an active exercise programme to their control group while Engsberg et al., (2006) attempted to provide a ‘no treatment’ control.

Outcomes
The functional objective outcome measures used were: Gross Motor Function Measure (GMFM), self selected gait speed, loaded STS, degree of crouch gait, 3D gait analysis, 10 metre shuttle run, muscle power sprint test, 5 metre sprint test, timed stair test and TUG. Outcome measures acting as supporting frameworks for function included: 1RM, muscle strength 30 second RM, lower limb muscle strength measured by a handheld dynamometer, PCI, ankle plantarflexor spasticity and end range dorsiflexion (Table 2). All outcome measures were valid and reliable, however after analysis of the literature the suitability of the GMFM was questioned by this review (Russell et al, 2000; Taylor et al, 2004b). Three trials reported subjective outcome measures, those measuring children’s perspectives of functional competence were: the Health Related Quality Of Life questionnaire (Engsberg et al, 2006), the Pediatric Quality of Life Measure (Engsberg et al, 2006), the Self-Perception Questionnaire (Unger et al, 2006) and the Self Perception Profile for Children (Verschuren et al, 2007). Finally the Children’s Assessment of Participation and Enjoyment (Verschuren et al, 2007) measured participation and enjoyment.

All studies indicated the clinical importance of their findings and documented short term follow up (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007). Three studies stated completing long term follow up (Dodd et al, 2003; Seniorou et al, 2007; Verschuren et al, 2007) (Table 1).

The results yielded from the studies are as follows (Table 2): statistically significant improvements were found in lower limb strength (p<0.05) following strengthening exercises (Dodd et al, 2003; Seniorou et al, 2007; Verschuren et al, 2007). The exceptions were knee extensor (Liao et al, 2007) and hip extensor strength (Seniorou et al, 2007) (p>0.05). Additionally strengthening programmes significantly improved participants’ GMFM scores in four studies (Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007) while no significant difference was found in two (Dodd et al, 2003; Verschuren et al, 2007). Furthermore statistically significant improvements (p<0.05) were found in 1 Repetition Maximum Sit To Stand (RM STS)(Liao et al, 2007), Physiological Cost Index (PCI) (Liao et al, 2007), degree of crouch gait (Unger et al, 2006), Timed Up Go (TUG) scores (Salem & Godwin, 2009), 10 metre shuttle run test (Verschuren et al, 2007), muscle power sprint test (Verschuren et al, 2007) and the 5 metre sprint test (Verschuren et al, 2007). Seniorou et al., (2007) reported a statistically significant increase (p<0.05) in normalised walking speed however changes in
all other gait parameters were not statistically significant (p>0.05) (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Seniorou et al, 2007). Engsberg et al., (2006) reported non-significant changes (p>0.05) in end range dorsiflexion. Finally three studies included subjective outcome measures, two yielded statistically significant improvements (p<0.05) (Engsberg et al, 2006; Unger et al, 2006), while one did not (p>0.05) (Verschuren et al, 2007).

**Statistics**

Five studies failed to provide sufficient data for their statistical tests to be reproduced and verified (Dodd et al, 2003; Engsberg et al, 2006; Salem & Godwin, 2009; Unger et al, 2006; Verschuren et al, 2007). Appropriate statistical analysis tools were used by five studies (Dodd et al, 2003; Liao et al, 2007; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007), however it was unclear whether Salem and Godwin (2009) used the correct t-test. In addition this review considered the t-test employed by Engsberg et al., (2006) to be inappropriate (Howell, 2004) (Table 1).

**PEDro (Table 3)**

The average PEDro score was 5.6 (range 3-8) (Physiotherapy Evidence Database, 2010). The quality of studies within this review were high (6-8) (Dodd et al, 2003; Salem & Godwin, 2009; Verschuren et al, 2007) and fair (5) (Liao et al, 2007; Seniorou et al, 2007; Unger et al, 2006). However the Engsberg et al (2006) study scored 3 and was deemed poor by PEDro.

One study was deemed by the PEDro scale to have failed to perform adequate randomisation (Unger et al, 2006). After email correspondence with PEDro this was altered (PEDro, 2010), meaning all studies successfully achieved adequate randomisation (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007). Three studies successfully concealed allocation (Dodd et al, 2003; Salem & Godwin, 2009; Verschuren et al, 2007), and baseline similarity was achieved in five studies (Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007). Four studies reported a 15% or more loss of participants to follow up (Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Unger et al, 2006) and intention-to-treat analysis occurred in two studies (Dodd et al, 2003; Verschuren et al, 2007). Blinding of participants and therapists was not possible. However five studies performed assessor blinding (Dodd et al, 2003; Liao et al, 2007; Salem & Godwin, 2009; Unger et al, 2006; Verschuren et al, 2007), with one study reporting this was breached (Salem & Godwin, 2009).

**Cochrane risk of bias (within study) (Table 4)**

Sequence generation is the first domain and five studies were deemed to provide insufficient information to permit judgement of a high or low risk of bias (Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Verschuren et al, 2007), while two were awarded a low risk of bias (Dodd et al, 2003; Unger et al, 2006).

Dodd et al (2003) adequately concealed the randomisation process, while Unger et al., (2006) was classed as high risk of bias. The remaining studies were an uncertain risk of bias (Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Verschuren et al, 2007).

Four studies scored a high risk of bias due to insufficient blinding (Engsberg et al, 2006; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006). Remaining studies were classified as having a low risk of bias as the outcome assessor was blinded and the non-blinding of participants was unlikely to have introduced bias (Dodd et al, 2003; Liao et al, 2007; Salem & Godwin, 2009; Verschuren et al, 2007).


For other risks of bias two studies scored a low risk of bias (Seniorou et al, 2007; Unger et al, 2006) and five studies were awarded a high risk of bias (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Verschuren et al, 2007).
Discussion

Summary of evidence

To the researchers’ knowledge this is the first systematic review of RCTs focussing exclusively on strengthening exercises as an intervention to improve function for patients with CP. Previous research has been divided over the efficacy of strengthening exercises (Anttila et al, 2008; Darrah et al, 1997; Dodd et al, 2002; Scianni et al, 2009; Verschuren et al, 2008). RCTs were reviewed as they have long been described as the ‘gold standard’ approach for evaluating therapeutic interventions (Meldrum, 2000; Pocock, 1983; Schulz & Grimes, 2002). Both statistically significant and non-significant results were reported by the studies across a variety of outcome measures. Overall the seven studies support the use of strengthening exercises for patients with CP (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007), however the presence of methodological flaws and bias limit the strength of the studies’ results.

This review found similar results to previous research across gait parameters (Scianni et al, 2009). Overall studies reported improvements in gait however they failed to reach the statistically significant threshold. Scianni et al., (2009) suggest that for patients with CP who are ambulating or have a lower classification of disability, strength increases would have a minimal effect on gait. This
is applicable to the population of the studies examining gait in this review (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Seniorou et al, 2007). This review therefore proposes that if gait improvements were the sole aim of a physiotherapy intervention, strengthening exercises alone may not be the optimum treatment option.

The lack of significant strength gains in the anti-gravity muscles (Liao et al, 2007; Seniorou et al, 2007) is important as they play a major role in ambulation. Therefore the non significant results limit the confidence in which conclusions can be drawn regarding the effectiveness of strengthening exercises in improving function. Seniorou et al., (2007) justify that accurate measurement of hip extensors is difficult to perform (Nadler et al, 2000), which may have contributed to the non significant results.

**Limitations**

When considering participant selection, sample size calculation is crucial for RCTs (Batterham & Atkinson, 2005; Schulgen et al, 2005). Researchers should document power calculations to determine minimal sample size necessary to show significant results (Pocock, 1983). Four studies’ lack of justification for their samples (Engsberg et al, 2006; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006) leaves the possibility of arbitrary recruitment based on convenience and availability (Whitley & Ball, 2002). However due to the challenge of obtaining participants in this population their results should not be dismissed and could still have clinical application. Documentation of power calculations by the three studies (Dodd et al, 2003; Seniorou et al, 2007; Verschuren et al, 2007) strengthens their argument and confidence when applying their results in clinical practice.

Baseline imbalance can introduce significant bias, render statistical tests inaccurate and introduce the possibility of the differences between trial groups post intervention being a consequence of patient characteristics (Roberts & Torgerson, 1999). This is relevant for Dodd et al (2003) as the experimental participants were classified more physically disabled by the GMFCS and this imbalance potentially limits this authors’ claim of intervention effect (Roberts & Torgerson, 1999). Baseline similarity across the remaining six studies instils reliability and confidence, allowing practitioners to make informed decisions about the applied intervention.

Efficient randomisation via generation of an impartial sequence is fundamental to ensure RCT groups are free from selection bias. The PEDro scale (Physiotherapy Evidence Database, 2010), published online, stated that Unger et al (2005) failed to employ suitable randomisation. The four researchers sought clarification from the PEDro authorities, as within the study’s methodology the authors had stated ‘subjects were systematically randomized’ (Unger et al., 2005 p471). The PEDro authorities subsequently agreed by email correspondence with the researchers and this will be reflected in the online PEDro scale from June 2010 (PEDro, 2010). The adequate randomisation procedures of all seven studies strengthen the credibility of their results (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007).

Alongside randomisation, allocation concealment from all involved is vital to eliminate selection bias (Kang et al, 2008). An effective randomisation protocol can be undermined by a poor procedure to conceal allocation (Altman & Schulz, 2001), as successful concealment reduces selection bias, while failure to do so could result in a non-randomised trial (Forder et al, 2005). As four authors do not detail explicit information regarding their allocation concealment process (Engsberg et al, 2006; Liao et al, 2007; Seniorou et al, 2007; Unger et al, 2006), clinicians must analyse these positive results cautiously as the possible presence of selection bias could distort these results.

Pocock (1983) states that in a well executed trial, participant compliance should be high and clearly documented. This enables the reader to judge whether positive results are due to the intervention. Contrary to this documenting participant compliance can help to determine if negative results were because of an ineffective intervention, poor participant compliance or other factors. Stevenson et al (2007) report that participation is known to be significantly lower in patients with CP so it is to the credit of the six studies who supervised their subjects to ensure the strengthening exercise programmes were performed as designed (Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007). Dodd et al.’s (2003) failure to supervise or measure participant compliance means that their positive results must be further analysed before clinicians can apply their intervention into practice as there may have been other factors contributing to these positive results.
It is important that authors document the precise details of a RCTs’ experimental and control intervention to enable the reader to assess for bias or validity (Pocock, 1983), or potentially repeat the intervention. The poor description of control interventions across studies does not exclude the possibility that strengthening exercises were part of routine physiotherapy; thus making it difficult to identify what experimental groups were being compared to (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007). Adapting an intervention to a clinical situation can be complicated (Day & Altman, 2000) and the studies’ lack of intervention detail heightens these difficulties (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007).

Double blinding is considered an important methodological feature of a RCT (Day & Altman, 2000). However participant and therapist blinding was not achievable due to the practicalities of blinding against strengthening exercises (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007). Conversely blind outcome assessment is essential for reducing bias, considering the studies’ inability to blind participants and therapists (Day & Altman, 2000). This questions the strength of two studies, who failed to report outcome assessor blinding (Engsberg et al, 2006; Seniorou et al, 2007) and another study where outcome assessor blinding was breached (Salem & Godwin, 2009). This potential bias means the statically significant results advocated by these two studies, could be skewed by their insufficient blinding. Therefore their results must be reviewed with caution before implementing these interventions into practice (Forder et al, 2005).

The GMFM is considered the gold standard for measuring gross motor function in patients with CP (Josenby et al, 2009). However Russell et al (2000) question its sensitivity for patients with CP over the age of five and those who ambulate with assistive devices. These are common characteristics of the population reviewed (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007). Furthermore, the GMFM was designed to assess changes over time (Josenby et al, 2009) and due to the relatively short duration of the studies reviewed, significant differences may not have been detected. These are confounding factors as the GMFM was used in all the studies except one (Unger et al, 2006) and could have contributed to the non-significant results reported by two studies (Dodd et al, 2003; Verschuren et al, 2007). This is important to clinicians as potentially relevant results may have gone undetected, which could further advocate the use of strengthening exercises to improve function in patients with CP.

Subjective outcome measures are vital in assessing treatment outcomes for patients with chronic conditions such as CP (Bjornson & McLaughlin, 2001), as researchers and health care providers must demonstrate the effectiveness of interventions from patients’ perspectives (Dodd et al, 2002; Jensen et al, 2000). The results of subjective outcome measures in three studies supported strengthening exercises for patients with CP (Engsberg et al, 2006; Unger et al, 2006; Verschuren et al, 2007). Although considering the studies (Engsberg et al, 2006; Unger et al, 2006; Verschuren et al, 2007) were unable to blind participants this could have induced different responses and affected treatment outcome; Liao et al (2007) state non-blinded experimental subjects may have greater psychological encouragement than control counterparts. Despite this, patients’ views on their function are important and can provide additional evidence for the use of strengthening exercises. This is useful when considering the equivocal nature of the evidence base and the drive towards patient-centred practice (Potter et al, 2003).

This review acknowledges that CP is a lifelong condition. Therefore it was to the credit of the studies who investigated the maintenance of functional gains over a longer period of time (Dodd et al, 2003; Seniorou et al, 2007; Verschuren et al, 2007). Dodd et al., (2003, p657) proposed that functional improvements maintained at long term follow-up could be due to ‘changes in everyday physical activities’. The authors suggest this could be due to the application of their improved functional ability and not purely the intervention alone. Due to the chronicity of CP this review deemed the maintenance of improved functional ability at long term follow-up to be particularly pertinent to clinicians treating patients with CP (Krakovsky et al, 2007).

Intention-to-treat analysis is an important component of the RCT, as trials failing to conduct it tend to overestimate their treatment effect (Hollis & Campbell, 1999). Nich and Carroll (2002) stated that intention-to-treat analysis was rarely conducted and this review’s findings agree as five
papers did not report intention-to-treat analysis (Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006). This review deemed this insignificant as drop-out rates and participant compliance, where reported, were considered acceptable. However excluding participants from follow-up biases the evaluation of treatment. The significance of this is evident in one study (Engsberg et al, 2006) where researchers dismissed certain participants from final follow-up due to a lack of strength gains. Their actions bias the statistical analysis and mean a heightened intervention effect would have been produced. Thereby clinicians reading the Engsberg et al., (2006) study, which supports the efficacy of strengthening exercises, must be aware of the distorted nature of these results.

The statistical report of a study needs to be clear and calculations should aid the reader’s interpretation of results (European Medicines Agency, 2010). Engsberg et al., (2006) selected the paired t-test but as four groups of data were involved they should have used repeated measures ANOVA (Howell, 2004). Therefore the p-values generated from this inappropriate test will be inaccurate reducing confidence in their results. Furthermore Salem and Godwin (2009) reported using the independent t-test, whereas their results indicate they used a combination of the independent and paired t-test due to their paired and unpaired data. Coupled with a suspected typing error this hinders correct interpretation. Inadequate statistical presentation by all studies (Dodd et al, 2003; Engsberg et al, 2006; Liao et al, 2007; Salem & Godwin, 2009; Seniorou et al, 2007; Unger et al, 2006; Verschuren et al, 2007) mean the reader cannot verify the statistical analysis and impairs interpretation of the studies’ results (Pocock, 1983).

The limitations of this review were primarily within the search and selection process. Language constraints meant only articles written in English were considered. Various combinations of search terms were used therefore this was not a repeatable, systematic search strategy. The retrieval of articles overlooked paper copies which could have resulted in relevant articles being missed. Furthermore the university database did not filter for duplicates of articles; therefore the researchers hand filtered the results, with the potential for human error. Titles that did not include ‘cerebral palsy’ or ‘spastic diplegia’ were excluded potentially neglecting appropriate studies. Another limitation was the stringent exclusion criteria as patients with CP commonly have co-interventions.

This review focussed exclusively on patients with CP; however the results could be tentatively applied to other neurodevelopment disorders. The limited age range of patients studied means comment cannot be made for adults with CP. The seven studies reported strengthening exercises, in varying forms and settings, can lead to functional gains. However this review did expose recurring errors across studies, providing the foundation to make recommendations for future research. In order to determine the most productive and cost-effective mode of delivery, quality research avoiding the highlighted methodological limitations must be conducted. The researchers propose future RCTs should include well-justified sample sizes and conduct long term follow-up, to assess the maintenance of functional gains. Finally researchers should measure compliance and participants’ perspectives of their functional abilities.

Conclusion
In conclusion this review focussed exclusively on strengthening exercises as an intervention to improve function for patients with CP. The studies included in this review support the growing body of evidence for their inclusion in the management of patients with CP. This review identified that strengthening exercises, in a variety of settings and forms, can improve functional activities including STS, standing, walking, running and jumping. Further improvements noted were muscle strength and a child’s perception of functional ability. However this review proposes that if improvements in gait are the sole aim of the physiotherapy intervention, the results indicate the benefits of strengthening exercises are minimal, especially when treating patients who can ambulate and are less physically disabled. The strength of the studies’ argument is hindered by elements of bias and methodological limitations and this review therefore recommends quality future research is necessary, to further examine the efficacy of this intervention for practitioners managing patients with CP.

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References


Dodd, K.J. Personal correspondence email received March 10, 2010.


Financial Implications of Case Management during Transition – A Case Report

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Introduction
This article explores the financial impact of a successfully managed transition from children’s services to adulthood.

This study, carried out in July 2010, aimed to highlight the cost to the paediatric health economy of a baby diagnosed with cerebral palsy from birth to the age of 18 years; and then to compare the cost of the next 10 years by creating two follow up scenarios whereby one had no transition planning and the other had a managed transition coordinated by Case Managers for Health Transition from NHS Walsall Community Health. It is hoped this article will demonstrate the cost effectiveness of an appropriately managed transition.

The Health Transition Team in Walsall was commissioned in January 2009 to create a Health Transition Case Manager Service which would support young people from age 14 to 25 years with a significant physical impairment in mainstream education to transition into adulthood. The team currently consists of 2.25 WTE case manager posts. Two of the case managers are former paediatric physiotherapists, and one is a former nurse. One case manager still works as a paediatric physiotherapist 1 day a week in the private sector.

The case manager role is unique and much of the work is ground breaking and innovative. As the role of the Case Manager for Physical Impairments is a first of its kind, it was clear that there was no evidence to support it. It was a concern that in a worsening financial climate that the service might be at risk of being de-commissioned, as it might not be seen as a frontline acute service.

Despite a wealth of excellent anecdotal evidence gathered by the team over the first 18 months from patient stories, workshop feedback, patient satisfaction and quality outcome audits, the team realised that the commissioners also needed evidence of the financial implications. The health transition team felt it was imperative to gather data to demonstrate the cost effectiveness of their service. In the absence of actual evidence two hypothetical scenarios were costed to give an indicator of possible outcomes.

The team undertook a study to determine the cost to the health economy of a child with Cerebral Palsy from birth to age 18, and then to compare the costs over the next 10 years of a young person who had a managed transition versus one with no transition.

The case managers utilised their previous physiotherapy and nursing experience to create Debbie - Debbie was based on real clients and was felt to represent an average scenario. At the age of 18 years she assumes two personas, both based on real case studies that the case managers had worked with in their previous roles.

Scenarios
Debbie has spastic diplegic cerebral palsy. She was born at 27 weeks gestation and spent 9 weeks on a neonatal unit. She was initially monitored monthly by the acute physiotherapists post-discharge but diagnosed at 3 months of age and transferred to community care. She had weekly physiotherapy for the first 6 months then joint fortnightly visits with community physiotherapists and occupational therapists until aged 3 years. Visits then became monthly until she started full time mainstream school at age 5 years. She also attended the weekly specialist baby groups at the Child Development Centre and was seen by a specialist speech and language therapist, feeding specialists, and specialist nursery nurses. Therapy visits continued termly whilst she was in infant school and then termly in junior and senior schools. She was seen by the speech therapy department monthly for 2 years to address her speech difficulties.

Debbie attended reviews with the Paediatric Consultant at 6 monthly intervals in the community and had yearly reviews at the Manor Hospital with her Consultant Paediatrician. At age 11 years she had multi-level orthopaedic surgery that included bilateral derotational osteotomies, tendon releases and transfers.
At 18 years of age Debbie walked short distances with a Kaye walker and used a wheelchair for longer distances, she wore bilateral ankle foot orthoses (AFOs) to control the position of her feet and ankles. Debbie had annual Botox injections to reduce the tone in her adductors and gastrocnemius muscles. She depended on her mother to assist her for dressing, washing, showering, toileting, preparing all her meals, driving her around.

Follow up scenario 1: No transition planning
At 18 Debbie was discharged from paediatric services, and was not given any contacts for adult services. She left school with 6 GCSE's A-C and 2 A levels grade D. Debbie had had work experience working in the library at her own school. She did not look for a job as she felt that she would not be able to manage to get to work on time in the morning because her routine was dependent on her mother assisting her with bathing and getting dressed each day. She was also worried about being able to access a work placement, as she had never had any meaningful work experience. She continued to live with her mother and father as she could not imagine how she would cope without their help. Her mother could not go to work, as she was needed at home to make Debbie's meals, toilet her, and to drive her around. Her father only worked part time as he also had to help with some of Debbie's care.

Debbie spent her days sitting on the settee all day watching daytime TV. She had no social activities, as all her friends had moved on and left home, and so she became isolated; her mental state deteriorated and she became very depressed.

Debbie no longer wore her AFO's as they didn't fit anymore and therapy had been discontinued. She found walking increasingly difficult and relied on her wheelchair more and more. Her muscles became shortened. Personal care was more difficult as her joints became more contracted. She eventually went to her GP who referred her to an adult Rehabilitation Consultant, who in turn, referred her for physiotherapy. Unfortunately her joints were too contracted for therapy to be effective so she was referred for corrective surgery for a second time to release her hips, knees and ankles at a specialist orthopaedic centre. She required extensive rehabilitation and spent 6 weeks in hospital following the operation. At home she required ongoing intensive physiotherapy and hydrotherapy for the next 3 months to get her back on her feet. Her GP also referred Debbie to adult mental health services to address her depression and prescribed long term medication. She continued to require a high level of physiotherapy and hydrotherapy over the next few years to maintain her mobility.

Follow up scenario 2: Worked with the Health Transition Team
Debbie had had work experience in an office inputting data on a computer system for the council - arranged through the Realising Aspirations Advisor at Education Walsall. They had been so impressed with her performance that Debbie was offered a job when she left school and was quickly promoted. Access to Work provided adaptations to her work environment to enable her to be independent. Debbie used her direct payments to pay a carer to help her get dressed in the morning and arranged for the same carer to visit her at work at lunchtime to toilet her and help her to eat.

She learned to drive at 16 following an assessment at the Regional Driving Assessment Centre and used her mobility allowance to fund her own adapted car so that she could get to work, and out and about with friends, independently.

Debbie engaged with Adult Health Services and had annual reviews with the Community Neurological Rehabilitation Team with short blocks of treatment, if required, to address any issues. Her medical needs were met.

Debbie still used her Kaye walker and only needed her wheelchair occasionally.

Debbie spoke to her social worker about moving out into her own adapted flat, and investigated all the aids and adaptations she needed to be as independent as possible. She was also aware of the benefits she was entitled to, to pay for the personal care she required. Both Debbie's parents were in full time employment - her mother had used her experience of caring for Debbie to train as a Learning Support Assistant in a school.

Debbie enjoyed socializing with her friends, going to the pub and had a boyfriend.
Method
Using the current patient pathways used at Walsall Manor Hospital and Walsall Child Development Centre, a spreadsheet was devised which itemised all the interventions, equipment, staff contacts, and medical and surgical intervention that Debbie would need.

The costs were calculated using current equipment prices and staff reference costs to reflect the financial demands on the health service in 2010.

Local commissioners and finance departments were very helpful in supplying the cost of neonatal unit episodes, and staff, clinic, and orthotic reference costs. The team used internet searches to identify the current cost of commonly used equipment such as specialist seating and standing frames. The local wheelchair services team was very helpful with providing the cost of major buggies and the various sized wheelchairs Debbie would need as she grew.

As all Botox treatment and orthopaedic surgery is carried out in specialist hospitals in other trusts, it was much more challenging to locate the cost of these treatments. Persistence and countless phone calls eventually led to the right people who were able to supply the cost of the care packages.

Results
Table 1: Breakdown of costs on an annual basis: 0-18 years

<table>
<thead>
<tr>
<th>Year</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>£143,269.78</td>
<td>£143,269.78</td>
</tr>
<tr>
<td>Year 2</td>
<td>£14,601.57</td>
<td>£14,601.57</td>
</tr>
<tr>
<td>Year 3</td>
<td>£11,022.44</td>
<td>£11,022.44</td>
</tr>
<tr>
<td>Year 4</td>
<td>£7,659.83</td>
<td>£7,659.83</td>
</tr>
<tr>
<td>Year 5</td>
<td>£4,866.09</td>
<td>£4,866.09</td>
</tr>
<tr>
<td>Year 6</td>
<td>£2,424.77</td>
<td>£2,424.77</td>
</tr>
<tr>
<td>Year 7</td>
<td>£2,663.21</td>
<td>£2,663.21</td>
</tr>
<tr>
<td>Year 8</td>
<td>£2,313.11</td>
<td>£2,313.11</td>
</tr>
<tr>
<td>Year 9</td>
<td>£3,456.11</td>
<td>£3,456.11</td>
</tr>
<tr>
<td>Year 10</td>
<td>£1,824.89</td>
<td>£1,824.89</td>
</tr>
<tr>
<td>Year 11</td>
<td>£28,815.23</td>
<td>£28,815.23</td>
</tr>
<tr>
<td>Year 12</td>
<td>£9,429.96</td>
<td>£9,429.96</td>
</tr>
<tr>
<td>Year 13</td>
<td>£9,549.84</td>
<td>£9,549.84</td>
</tr>
<tr>
<td>Year 14</td>
<td>£7,331.03</td>
<td>£7,331.03</td>
</tr>
<tr>
<td>Year 15</td>
<td>£4,942.81</td>
<td>£4,942.81</td>
</tr>
<tr>
<td>Year 16</td>
<td>£3,511.25</td>
<td>£3,511.25</td>
</tr>
<tr>
<td>Year 17</td>
<td>£3,496.47</td>
<td>£3,496.47</td>
</tr>
<tr>
<td>Total expenditure</td>
<td>£261,499.48</td>
<td>£261,499.48</td>
</tr>
</tbody>
</table>

The total investment by the health service for the first 18 years of Debbie’s care was £261,499.48 (see appendix 1 for the breakdown of costs).

The health transition team then separately costed the two follow up scenarios to determine the investment required over the next 10 years. They found that scenario 1 resulted in a cost of £52,919.36 to the health economy whilst scenario 2 cost a mere £8,421.60 demonstrating a saving of £44,497.76 over 10 years (see appendix 2 and 3 for the breakdown of costs).

Table 2: Comparison of the costs age 18-27 years scenario 1 compared to Scenario 2

<table>
<thead>
<tr>
<th>Year</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 18</td>
<td>£267.75</td>
<td>£690.51</td>
</tr>
<tr>
<td>Year 19</td>
<td>£267.75</td>
<td>£653.29</td>
</tr>
<tr>
<td>Year 20</td>
<td>£937.71</td>
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<td>Year 21</td>
<td>£27,828.16</td>
<td>£578.85</td>
</tr>
<tr>
<td>Year 22</td>
<td>£7,093.08</td>
<td>£578.85</td>
</tr>
<tr>
<td>Year 23</td>
<td>£5,345.72</td>
<td>£578.85</td>
</tr>
<tr>
<td>Year 24</td>
<td>£3,857.18</td>
<td>£578.85</td>
</tr>
<tr>
<td>Year 25</td>
<td>£2,364.46</td>
<td>£578.85</td>
</tr>
<tr>
<td>Year 26</td>
<td>£2,514.46</td>
<td>£1,673.85</td>
</tr>
<tr>
<td>Year 27</td>
<td>£2,443.09</td>
<td>£578.85</td>
</tr>
<tr>
<td>Total:</td>
<td>£52,919.36</td>
<td>£8,421.60</td>
</tr>
</tbody>
</table>

Discussion
This study highlights several important points.

The health economy may invest approximately £260,000 in each child with cerebral palsy by their 18th birthday. This does not include education or social care costs. The decision was taken not to adjust the costs to reflect inflation in the calculations as this was too variable.

It has been demonstrated that if a young person’s transition is not managed there is a risk that they will not fully engage with Adult Health Services which could potentially cost the health economy an extra £44,497.76 over the next 10 years.

Cases such as these often result in crisis management, and the investment made to take them to adulthood lost.

It is important to note that these post-18 scenarios reflect on the impact the health economy alone and do not include the costs of lost revenue to the tax department and the increased strain on social care services.
If their transition is successfully managed, the young person may be in meaningful employment, paying taxes, therefore contributing to the cost of their own health care. This would free their parents from the caring role and hopefully enable them to return to the job market and contribute to the economy.

The health transition team also supports young people with life-limiting conditions such as Duchenne Muscular Dystrophy and Spinal Muscular Atrophy. The cost of their healthcare often increases over the years as they deteriorate. This research suggests that the same scenarios may be applied to them. This might guarantee they access preventative services for as long as possible and ensure that costly specialist care might only be required towards the end of their life.

**Conclusion**

The health transition team concluded that a managed transition is helpful in reducing costs and improving outcomes for young people with physical disabilities. Support through transition will improve access to adult services and to employment.

### Appendix 1: Breakdown of costs for a service user aged 1–18 years

<table>
<thead>
<tr>
<th>Service Description</th>
<th>Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonatal Unit</td>
<td>£21.00</td>
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<tr>
<td>Physiotherapy B7</td>
<td>£37.22</td>
</tr>
<tr>
<td>Physiotherapist B4</td>
<td>£21.13</td>
</tr>
<tr>
<td>Occupational therapy B7</td>
<td>£37.22</td>
</tr>
<tr>
<td>Occupational Therapist B4</td>
<td>£21.13</td>
</tr>
<tr>
<td>Speech Therapy B7</td>
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</tr>
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<td>Feeding specialist</td>
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<tr>
<td>Consultant community</td>
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<td>Specialist Boots</td>
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<td>Botox treatment</td>
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</tr>
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</tr>
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<td>TAC reviews (average)</td>
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<tr>
<td>Orthotic per session</td>
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<tr>
<td>Hydrotherapy per session</td>
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</tr>
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<tr>
<td>Staying Positive workshops</td>
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<tr>
<td>RAPID events</td>
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**Total** 261,499.48
### Appendix 2 – Follow up Scenario 1

Cost breakdown for a service user aged 18 to 27 years who has not had a managed transition.

<table>
<thead>
<tr>
<th>Cost per unit</th>
<th>Year 18</th>
<th>Year 19</th>
<th>Year 20</th>
<th>Year 21</th>
<th>Year 22</th>
<th>Year 23</th>
<th>Year 24</th>
<th>Year 25</th>
<th>Year 26</th>
<th>Year 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiotherapy B7</td>
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<td>223.32</td>
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<td>Occupational Therapist B4</td>
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<td>501.70</td>
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<td>Pair of AFO’s</td>
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</tr>
<tr>
<td>Standing frame</td>
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</tr>
<tr>
<td>Night splints</td>
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<td>150.00</td>
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<td>620.00</td>
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<td>0.00</td>
<td>0.00</td>
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</tr>
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<td>Adult size w/ chair</td>
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<td>0.00</td>
<td>214.00</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td>Pressure cushion for wheelchair</td>
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<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
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</tr>
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<td>Orthotist per session</td>
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<td>25.00</td>
<td>0.00</td>
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Total: 52919.36

### Appendix 3 - Follow up Scenario 2

Cost breakdown for a service user aged 18 to 27 years who has had a managed transition.

<table>
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<th>Service Area</th>
<th>Cost per unit</th>
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<th>Year 20</th>
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<th>Year 22</th>
<th>Year 23</th>
<th>Year 24</th>
<th>Year 25</th>
<th>Year 26</th>
<th>Year 27</th>
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</thead>
<tbody>
<tr>
<td>Health Transition Team</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td>37.22</td>
<td>37.22</td>
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<td></td>
</tr>
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<td>126.78</td>
<td>126.78</td>
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<td>126.78</td>
<td>126.78</td>
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</tr>
<tr>
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<td>37.22</td>
<td>37.22</td>
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<td>37.22</td>
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<td>126.78</td>
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<td>250.85</td>
<td>250.85</td>
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<td></td>
</tr>
<tr>
<td>Pair of AFO’s</td>
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<td>300.00</td>
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<td>300.00</td>
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</tr>
<tr>
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<td>150.00</td>
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<tr>
<td>Botox treatment</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>615.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kaye Walker W3</td>
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<td>0.00</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>620.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult size wheelchair</td>
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<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
<td>214.00</td>
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<tr>
<td>Pressure cushion for wheelchair</td>
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<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>48.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthotist per session</td>
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<td>0.00</td>
<td>25.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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</table>

Total: 8,421.60
Does the peer assisted learning model of supervision increase the workload of physiotherapy & occupational therapy practice placement educators compared to the apprentice model? A mini review

Jane Reid MCSP, SRP, Pg Cert Frontline Leadership & Management
Associate AHP Director

Correspondence: email: jane.reid@nhs.net

Abstract

Within the United Kingdom all pre-registration physiotherapy and occupational therapy students must complete 1000 hours of supervised clinical practice as laid out by the standards for education and training (SET’s) which are regulated by the Health Professions Council (HPC 2009). The supervision on a practice placement has traditionally utilised the apprentice model whereby one educator supervises one student (NES 2006). However the evidence would suggest (Lekkas 2007, NES 2006, Stiller 2004) that the apprentice model is no more effective than other models of supervision including the peer assisted learning (PAL) model. The PAL model does facilitate a more autonomous practitioner (Bartholomai 2007) and would also appear to enable greater opportunities for team work which should only be to the benefit of students and educators. Despite this, anecdotal evidence continues to suggest that there is resistance from practice placement educators to adopt the PAL model, predominantly on the rationale that the PAL model would increase their workload. This mini review was therefore to answer the question: ‘Does the peer assisted learning model of supervision increase the workload of physiotherapy & occupational therapy practice placement educators compared to the apprentice model?’

The review has identified that with appropriate planning and some potential education prior to placements there is no significant increase in workload for the educator and that other factors would indicate that as a learning experience, PAL should be promoted and facilitated.

Background

Practice placements are integral to the pre-registration curriculum of the Allied Health Professions within the United Kingdom (AHP’s, Appendix 1). The duration and range of practice placements will vary across the AHP’s but all must comply with standards for education and training as set by the Health Professions Council (HPC 2009).

‘The number, duration and range of practice placements must be appropriate to support the delivery of the programme and the achievement of the learning outcomes.’ (Statement 5.2 HPC 2009)

The challenges in the provision of practice placements both nationally and internationally have been reported upon extensively (Huddleston 1999a; Lekkas et al 2007; Rodger et al 2008). The professions of physiotherapy and occupational therapy require their students to complete 1000 hours of clinical practice (BAOT & CSP online 2009) which must comprise a balanced range of experiences for students. The way that services are delivered and managed within the NHS is constantly evolving and this makes the delivery of placements increasingly challenging. In the last 5 years in Scotland, NHS Education for Scotland (NES) has taken a lead role in supporting the provision of practice placements within the territorial health boards for AHP’s (NES 2006; NES 2007) through the Practice Education Facilitation (PEF) programme.

The apprentice model (1:1) is the traditional way of providing practice placements with one student to one educator (NES 2006). Bartholomai and Fitzgerald (2007) comment that the experience of educators as students will influence how they provide placements. This is supported in practice as most educators were used to the apprentice model and they feel comfortable replicating this. However, this model is not necessarily the best or preferred option for students (Stiller et al 2004; NES 2006) and some of the negative elements to the apprentice model are highlighted in the table below.
The Peer Assisted Learning (PAL) Model; also known as the Collaborative Model and the 2:1 model, has been advocated as an alternative way to provide supervision for students whilst on practice placement (Ladyshewsky 2000, Baldry Currens & Bithell 2003). For the purpose of this review, the PAL model will be the term utilised and will include all models which include one educator supervising more than one student and facilitating peer learning amongst the students. In 2007 NES produced a guide (NES 2007) to support the introduction of new models of supervision to reflect the changing needs of health care. However, despite this, evidence from HEI placement lists as well as anecdotal evidence from practice placement educators would indicate that there is still resistance to adopting new models and the preferred model of use remains the apprentice model. Anecdotally, the main reasons given are that having 2 students increases the workload for the educators, and indeed in the study conducted by Bartholomai and Fitzgerald (2007) the barriers to implementation of the PAL model were identified as:-

- anxiety over perceived increase in workload of the educator
- fear by educators that they would be unable to manage more than one student
- time constraints for preparation
- compatibility and competitiveness between students

The purpose of this mini review is therefore to answer the following question: ‘Does the PAL model of supervision increase the workload of physiotherapy and occupational therapy practice placement educators compared to the apprentice model?’

Using the “PICO” method (MSU online 2009) to develop the question the following categories were identified:

**Population** – physiotherapy and occupational therapy educators supervising pre-registration physiotherapy or occupational therapy students on a practice placement

**Intervention** – peer-assisted learning (PAL) model of clinical supervision

**Comparator** – apprentice (1:1) model of clinical supervision

**Outcome** – workload for clinical educator

**Methodology**

The literature search was carried out during September and October 2009 and limited to the years 1999 – 2009 and also to peer-reviewed journal articles written in English. The following electronic databases were searched:-

- CINAHL (Cumulative Index to Nursing and Allied Health Literature)
- Ovid SP databases
  - Health Management Information Consortium
  - EMBASE
  - Ovid Medline
  - AMED (Allied and Complimentary Medicine)
- ERIC (Educational Resources Information Centre)
- Cochrane Database of Systematic Reviews

The search was divided into 2 sections the professions of occupational therapy and physiotherapy and also the learning model. The term physical therapy was included within search terms as it is the terminology that is more frequently used in literature outside the UK.

The initial search was conducted upon CINAHL and then repeated using Ovid SP databases accessed through NHS E-library using the key words separately and then combined as below:

- **Combination 1:** (education, clinical) and (physiotherapy or physical therapy or occupational therapy);
- **Combination 2:** (results from combination 1) and placements.

A total of 232 papers were retrieved and then further narrowed to identify the most relevant ones by reviewing the titles and abstracts. This identified a potential of 11 papers for inclusion into the mini review. In any review of literature it is imperative that there are clear inclusion and exclusion criteria, to enable the most relevant papers to be selected and prevent a deviation from the question being asked (Greenhalgh 2006).
The inclusion and exclusion criteria for this review are listed below.

**Inclusion Criteria:**
- papers published within English peer-reviewed journals between 1999 and 2009;
- reporting on the educators perceptions of the effect on their workload of the PAL model of supervision;
- PAL models which required no staffing increase or other resource implication.

**Exclusion Criteria:**
- PAL models which necessitated additional staffing resources of the same or different profession;
- papers that did not discuss the effect on the educators workload.

In applying the above criteria a total of 5 papers were identified as being relevant to this mini review; 2 of these were reviews and 3 were primary qualitative research. Qualitative research offers insights into perceptions and experience (Giacomini and Cool online 2009) and is therefore an appropriate research methodology to the subject material of this mini review. The qualitative studies identified are cohort studies and score 4 on the hierarchy of evidence (Greenhalgh 2006).

Greenhalgh (2006) refers to the hierarchies of evidence for primary and secondary research papers. In general the higher up the ranking the more robust and objective the research is presumed to be. However, Greenhalgh (2006) also identifies that not all papers published are methodologically perfect and it is therefore necessary to critically appraise papers, rather than accepting that every paper that is published should be applied to practice.

**Table 2: Hierarchies of Evidence (Greenhalgh 2006)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Systematic reviews &amp; meta-analyses</td>
</tr>
<tr>
<td>2</td>
<td>Randomised controlled trials with definitive results</td>
</tr>
<tr>
<td>3</td>
<td>Randomised controlled trials with non-definitive results</td>
</tr>
<tr>
<td>4</td>
<td>Cohort studies</td>
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<td>5</td>
<td>Case controlled studies</td>
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<td>6</td>
<td>Cross sectional Studies</td>
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<td>7</td>
<td>Case reports</td>
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The papers identified as the most appropriate to include in this review covered the period of 2003 – 2007, although it is acknowledged that the research was carried out earlier than this. The studies will be reviewed in chronological order as it might be reasonable to expect that later studies would have utilised recommendations or learning from the earlier ones. The the papers included and the order in which they will be reviewed (full references included in bibliography) are listed below:

1. Baldry Currens, J, and Bithell C (2003). The 2:1 Clinical Placement Model; Perceptions of Clinical Educators and Students;

**Descriptions of Studies**

The 5 papers were critically appraised utilising the checklists developed by the Critical Appraisal Skills Programme (CASP online 2009) and will be presented in chronological order as listed above.

**Study 1** Baldry Currens and Bithell (2003) cohort study clearly identified the issue to be investigated and the type of study is appropriate to the topic. The study included 12 NHS trusts and 34 placements across 5 different clinical specialities for physiotherapists (37 clinical educators in total and representative of clinical areas in most NHS Trusts). It could therefore be assumed that the findings from this study would be transferable and representative of the perceptions of clinical educators. The study was aimed specifically at examining the educator’s perspectives of the PAL model of placement.

The educators and managers across the Trusts were informed of the study and then self-selected to be a part of it. There is the possibility that this could provide a bias, however, it is also representative of normal clinical practice where an educator may offer to take students utilising the PAL model and therefore it is unlikely to compromise the findings.

The study did not match the students for traits or abilities on any of the placements and is therefore...
Inclusion and exclusion criteria were explained in part; however, the authors did not give an indication of e.g. the years to which they applied their search criteria nor if they included or excluded journals that were non English and were only peer reviewed.

Although the authors identified the databases and key words there was not enough information given to successfully replicate the search. A total of ten papers met their selection criteria and the papers were all summarised. There is however no indication that a clear strategy was utilised to assess the quality of the papers nor that there was more than one assessor.

This could potentially introduce some degree of bias in the review, particularly given the fact that the author is not only a lecturer at an HEI requiring practice placements, but also the primary researcher in a cohort study considering the perceptions of educators (Baldry Currens and Bithell 2003).

With the exception of one paper (Baldry Currens and Bithell 2003) the papers reviewed by Baldry Currens are all outwith the time period applied for this mini review. However, as there is a clear synopsis of the reviews and an extensive discussion the information does provide supporting evidence to answer the question posed here.

Although there are limitations with the process of this review, the findings and the discussion are extensive and objective. It should be possible to apply these in clinical practice across both physiotherapy and occupational therapy placements within the NHS.

Study 2 The literature review conducted by Baldry Currens (2003) was conducted to consider the evidence to support the implementation of the PAL model. However, out of its 4 aims two were congruent with this mini review: the practicability, delivery and resource issues for physiotherapy educators providing PAL placements.
potential for bias for trialling different models; however, as stated previously this is representative of normal practice. The authors do acknowledge the limitation that the size may have on the study; however they do not seek to justify it. As the educators were to experience different models, an attempt was made to eliminate order effects by randomisation of placement models where possible; however, due to time constraints, this was not always feasible and the authors acknowledged this limitation. The length of placement was not identified, however the location/clinical specialities were, which is potentially more helpful in being able to generalise findings. Additionally, all students were 3rd (final) year and although the programmes differ north and south of the border, it is helpful to have this as a benchmark.

Data collection was via semi-structured interviews for both and additionally a focus group interview for students, which is appropriate to this type of study (Giacomini and Cool online 2009). A broad overview of the topics discussed was given, however not in enough detail to replicate or fully analyse. There were differences in the topics for student and educator and although this is reasonable there was no justification given for this and may have therefore skewed data.

The interview questions were piloted, however it was unclear if this was with the cohort or a separate group and this could, in turn, have influenced the experience or expectation on the placement prior to the actual interviews. Analysis of the data was robust with a random 10% of transcripts checked by educator or student with no discrepancies identified.

The findings from the study are clearly identified and consider advantages and disadvantages of the different models. In some instances, the findings are presented from an educator and student perspective, therefore, it is more difficult to extrapolate the results purely from an educators’ perspective and this could limit the application of the study more widely.

It is surprising that although this study is acknowledged as part of a larger study, no significant reference is made to the other components of the study or that an occupational therapy cohort was being studied concurrently.

Study 4 Martin et al (2004) clearly identified the purpose of the study and that ethical approval had been obtained. The reasoning for a qualitative cohort study was explained and in fact the paper, although focussed upon occupational therapy, identified that the research had included physiotherapy and occupational therapy students. The study was located in an NHS setting in the UK, selection of educators was justified and although there may be the potential of bias in that it was a group of educators who provided most of the practice placements for this university, this would seem reasonable and indicative of ‘normal practice’. There is insufficient information on the selection of students for placements however; it would appear that was through routine allocation rather than matching specifically.

Unlike the previous study the duration of placements were identified. There were a total of 6 placements across clinical areas studied; however educators were only able to experience one model and this will therefore have limitations on the findings. There was no indication regarding the overall levels of the students on the 6 placements with the exception of the only 2:1 model where it was 2 first year students. This had a significant impact upon the practical arrangements of the model as students were unable to visit on their own this therefore limits the applicability of the findings, although the authors do address this by utilising findings from the physiotherapy component of the study.

Data collection was via semi-structured interviews for both and the authors acknowledge the option for follow ups were available should any of the data collected need further clarification. As in the previous study, a broad overview of the topics was given but it would be difficult to replicate exactly. However that is potentially a strength and a weakness of the semi-structured interview. Data analysis was described in depth and the authors acknowledged the greater need for ensuring rigour in qualitative research and identified the strategies they employed to ensure it.

Findings of the study were presented under specific headings enabling conclusions and learning to be taken from the research. It was helpful to integrate the findings from both the physiotherapy and occupational therapy components of the study as it made them more robust and applicable to clinical practice.

The study acknowledged that the research team might demonstrate bias towards PAL models;
however they did endeavour to minimise this with methods employed to ensure rigour. The authors also acknowledged the subjective nature of qualitative research as a limitation. However, when trying to analyse the effect of an intervention on individuals in this setting, it is the most appropriate method to employ.

**Study 5** Lekkas et al (2007) conducted a systematic review of models of clinical education. One of the key factors which they considered was the perspectives of the stakeholders and although not exclusive to the PAL model, it did meet the criteria of this review.

The review methodology is not only extensive but is described in considerable depth that would allow replication. The authors clearly identified and justified their inclusion and exclusion criteria and rate the papers they included using a hierarchy of evidence (CEBM online 2009). This also included a justification of the types of study they intended to include within the review. To ensure robustness of the appraisal process, 2 researchers utilised a validated checklist and then discussed and clarified any discrepancies.

The inclusion and exclusion criteria for the review were explained in depth and ensured the papers selected had been through a rigorous process prior to being analysed.

The results were presented under the headings of the placement model and a brief synopsis was given to explain each. Findings from each of the studies were not explicit and instead gave a summary under the headings of advantages, disadvantages and recommendations for each of the models of supervision. Therefore, the reference list was studied to ensure that no other relevant papers had been overlooked in the process of this review and as there were none it can be stated with a degree of confidence that the papers identified here are the only ones within the inclusion and exclusion criteria that address the question.

A total of 20 papers were reviewed which reported upon the PAL model; although not all of these included perceptions of the educators, some related to productivity and student competence. It identified that the need to pre-match students for PAL models was an area that, although outwith the remit of their study needed to be explored. In reality however, it is unlikely that if the PAL model becomes accepted that it would be practicable to always be able to pre-match students, particularly as many placement areas take students from different institutions.

Although the systematic review process was robust there is little information about any of the papers which limited the evidence available for this mini review. However, the authors justified their reasoning as the overall aim of the systematic review was to analyse and compare the differing models of clinical supervision.

**Findings**

The studies reported on a number of findings, however only those that are relevant to the workload of the educators will be discussed here. The majority of clinical educators in all studies expressed positive comments about the PAL model with 94.1% of the educators in Baldry Currens & Bithell study (2003) willing to use it again. Almost a third of the educators in this study reported that the PAL model had given them more time for other staff and other duties; had facilitated more efficient teaching and was more rewarding for the educator and had a positive effect on service delivery and promotion of team work. One of the clinical educators stated: “Having 2 students is not twice as difficult as having one…… in many ways it’s less, as you are able to use the 2 students to help with their own education” (Baldry Currens and Bithell 2003 p209)

Disadvantages not unsurprisingly included extra paperwork, monitoring different student’s needs and less time for own clinical work. However these were reported by a maximum of 15% of the clinicians. As several of the studies recommend that the students should have a minimum of 50% of the educators’ caseload, there should not be difficulties for the clinicians to complete their caseload.

One of the barriers identified by Bartholomai and Fitzgerald (2007) was in regard to compatibility between students and the potential increase in workload this could cause. However, in practice this did not arise as an issue in any of the studies and could actually be more beneficial in developing team working skills whilst a student.

All of the papers reviewed highlighted pre-placement planning and support from the HEI’s was imperative. Generally the HEI’s in Scotland are very supportive of clinical educators and would be happy to support any individual who wished to implement a PAL model; therefore the discussion reverts back to the ability to adequately prepare prior to the commencement of a placement. Although planning here is in particular reference to PAL placement provision, it is important to
acknowledge that for all placements planning is required to enable a successful placement. It is perhaps more important to consider the education required around peer learning and how to successfully facilitate it as a starting point rather than the specifics of different models of placement supervision. The studies on the whole reflected normal practice, in that educators agreed to take students for a PAL model without participating in any education as to the principles of peer learning.

Lekkas et al (2007) also identified the differences in terminology and provision of placements as a factor which hinders comparisons being made. Although this may well be the case, the PAL model is the preferred option from the HEI’s, not only from the peer learning perspectives of the students but also from the ability to increase capacity. Baldry Currens (2003) also acknowledge that although it is impossible to make conclusions over one model to another, there is sufficient information available to successfully employ strategies to enable a PAL model to be successfully facilitated. However, educators still need to be convinced that it is not more work for them for little gain.

Lekkas et al (2007) concluded that there was insufficient evidence to support any one model although it did acknowledge that this is in part due to the quality of research available to support or condemn any one model.

Conclusions and Recommendations

It is acknowledged that with the paucity of large scale studies it is difficult to make definitive claims with regard to the effect a PAL placement model has on the workload of educators. However, as was seen in the presentation of the findings from the above studies, there is enough congruence, which along with the NES guide (NES 2007), should ensure that more educators would consider trying this model of placement and a repository of evidence might be able to be gathered.

Within Scotland, NES, through the PEF programme, could facilitate this across the territorial health boards. Bringing together the findings of individual case examples would add further evidence, allow bias to be limited as much as possible by including educators from across the country and students from a variety of HEI’s.

In addition to the NES guide (NES 2007), the recommendations from Bartholomai and Fitzgerald (2007) should assist educators plan a PAL placement once they have decided to try it. These are again around preparation prior to the placement but give practical suggestions including:

- teaching packs including tutorial and supervision records available prior to offering a placement;
- timetable peer supervision sessions;
- timetable individual supervision sessions;
- allocating a minimum of 50% of educators caseload to the students.

It is acknowledged that the PAL model is not necessarily suitable for all levels of students nor for all clinical areas however, evidence would suggest that in the majority of cases where a PAL model is adequately prepared and planned for, there is not a corresponding increase in the workload of the educators. However, until more educators try it out it is likely that the benefits for students and educators of the PAL model will not be fully realised (Lekkas et al 2007, Ladyshewsky 2002).

As a first step towards this, it would be helpful if HEI’s were able to offer educators some form of education around the benefits of peer learning and ways to facilitate it. Often, educators assume that the push for a PAL model is around increasing capacity rather than also facilitating a more effective learning experience. Evidence has shown that on PAL placements students are more autonomous (Baldry Currens 2003; Bartholomai and Fitzgerald 2007; Stiller et al 2004) and this is certainly a characteristic that is required on graduation and should be promoted at pre-registration also.

This mini review is limited due to the paucity of studies available; however the combination of 3 qualitative research studies and 2 reviews has enabled an informed review to be made. An effective search of the literature identified appropriate papers which have been further supported by literature available via NES and other papers discussing the issues around placement provision from a wider perspective. The review has identified that with appropriate planning and some potential education prior to placements there is no significant increase in workload for the educator and that other factors would indicate that as a learning experience, PAL should be promoted and facilitated.

References


Huddleston R (1999b) Clinical placements for the professions allied to medicine, part 2: placement shortages? Two models that can solve the problem; British Journal of Occupational Therapy; 62 (7); 295-98.


Appendix 1 – Professions comprising the Allied Health Professions

- Arts Therapies including Music, Drama & Art
- Chiropody & Podiatry
- Diagnostic Radiography
- Nutrition & Dietetics
- Occupational Therapy
- Orthoptics
- Physiotherapy
- Prosthetics and Orthotics
- Speech and Language Therapy
- Therapeutic Radiography
Protecting the Future of Paediatric Physiotherapy
A Report on a Paediatric Physiotherapy Peer Assisted Learning Pilot in Scotland

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Introduction
Practice placements are an integral component of all pre-registration physiotherapy curricula (HPC 2009) and although there needs to be a variety within this, it is not a pre-requisite that a paediatric placement is part of this. Spiliotopoulou (2007) and Thomas et al (2007) both comment upon the influence between practical experience as a student in a clinical area and future career choice. Their papers indicate that if a student has a placement within a specialist area that they enjoy they are more likely, if possible, to seek employment within that area. Scoping work conducted by NHS Education for Scotland (NES) in 2009 identified that although some paediatric physiotherapy departments offered placements, there were many that didn’t and potentially there is untapped potential for more students to be exposed to the ‘excitement’ of working in paediatrics and therefore more students who would wish to explore paediatrics as a career option. When this is considered alongside the paediatric workforce data, (from the collated regional workforce advisors statistics), indicating that there may be a significant number of retiral in the next 5-10 years and the fact that the numbers of physiotherapists required to treat an ageing population will need to increase (SEHD 2006), unless paediatric physiotherapists are pro-active, then this could have an adverse effect on future recruitment and sustainability of services.

Traditionally many practice placement educators have supervised students using the apprentice or 1:1 model (NES 2006). However, research would indicate that this is not necessarily the most effective model (Lekkas 2007, NES 2006, Stiller et al 2004) and that a Peer Assisted Learning (PAL) model may offer greater options for educators, students and Higher Education Institutes (HEI’s). NHS Education for Scotland (NES), a Special Health Board, established the AHP Practice Education Facilitation (PEF) Programme in 2006. One element of the PEF programme is supporting the territorial health boards in Scotland and their practice placement educators to consider alternative options for placement supervision and also facilitating the development of new placement opportunities (NES 2006, NES 2007). It was with both these aspects in mind and previous experience as a paediatric physiotherapist and manager that the author of this paper approached a willing paediatric physiotherapy department within a community health partnership in NHS Scotland and a supportive HEI to pilot a PAL paediatric physiotherapy placement. This paper reports upon the pilot and the lessons learnt from it, which have subsequently led to other professions and departments trialling innovative models of supervision.

The Paediatric Pilot
Prior to setting up of the pilot a number of educational sessions had been organised to raise awareness and understanding of the different models of supervision and also to address the myth that many physiotherapists still held, that part-time staff could not be practice placement educators. The purpose of these sessions was awareness raising but also to improve the quality of education for students and to support any individuals who had not taken students for some time to start taking student again. Following on from these one of the paediatric physiotherapy departments expressed a willingness to start taking students again after a break of several years and were interested to pilot a new way of supervising the students.

PAL Model of Supervision
The PAL model (NES 2007) of supervision encourages students to use each other for mentoring and support as well as working with the clinical educator. Although evidence to date (Lekkas et al 2007) indicates that no one model of supervision is superior to another, the PAL model was chosen to offer students support and to have the opportunity to evaluate its efficacy in a paediatric setting. Traditionally placements have utilised an apprenticeship model where there is one educator and one student (Daniels 2007) although Chartered Society of Physiotherapy (CSP 2002) offered guidance on different models as far back as 2002. In 2006 NES completed the AHP Practice Placements Pilot, which was the pre-cursor to the AHP PEF programme, and at that time a number of negative features of the apprentice model were commented upon which included dependence on supervisor, not
being reflective of the active learning and peer learning which is a regular feature of pre-registration education and time pressures on educator. Discussions were held with the practice placement educators, the HEI and the AHP Education Lead and all were in agreement that this would be a good placement to pilot a PAL model of supervision.

Methodology

Setting & Educators

The paediatric physiotherapy department consists of 5 part-time physiotherapists with many years of clinical experience and expertise between them. All had supervised students in the past but this was between 2 and 5 years previously; all were quite anxious re. their ability to provide a good learning experience for the students. None of the educators had received any formal training to become a practice placement educator, although one had attended a session facilitated by the AHP Education Lead the previous year. The educators had no experience of 2 students on placement together.

Each of the physiotherapists would be an ‘educator’ for the students with one of the educators being the lead and co-ordinator. As the physiotherapists were all part-time they acknowledged that they would need to be very pro-active around communicating the progress of the students. It was agreed that the educators would give informal feedback to the students on a daily basis and a formal session was arranged weekly with the lead educator prior to their formal assessments allowing each educator to contribute to the assessment process.

The department covers the broad spectrum of paediatric services and had the ability to give students experience of:

• integrated therapy team; including Occupational Therapy, Physiotherapy, Speech & Language Therapy, Podiatry;
• hydrotherapy;
• out-patients; predominantly musculo-skeletal;
• school - mainstream and special;
• plaster clinic;
• talipes clinic.

The placement was intended as the first of many, however the physiotherapists wanted to ensure that the experience was a development opportunity and an evaluation of it was built in from the start to inform the provision of future placements. This was to be conducted by the AHP Education Lead and although not impartial she has the responsibility within the Health Board area to ensure placements provide a quality learning experience for students and that there is, in general, a learning culture across the organisation.

Students

Both students were in their 4th year and this was their second last placement prior to qualification. One student had already had a paediatric neurology placement and both had placement experience in orthopaedics, out-patients, neurology and cardio-respiratory. The placement was 6 weeks duration and although neither student had been on placement with another student previously both had experience of multiple educators.

Pre-Placement

The practice placement educators met with AHP Education Lead, course leader and lecturers from the HEI. Topics, including student feedback, supervision, assessment and models of supervision, were discussed and clarified for the educators. The educators identified the best methods for them to gather evidence of the students’ progress and how they would communicate this between themselves. They also identified that it would be essential for students and educators to know when the students were expected to be working together and when they were working individually and therefore a programme was developed prior to the students starting. The programme ensured that students gained as wide a clinical experience as possible and had the opportunity to work with different professions and agencies which is a core feature of being a paediatric physiotherapist. The programme also ensured an equitable share between the clinical educators.

Evaluation

From the outset of planning this placement it was agreed that it would be evaluated by the AHP Education Lead, from an educator and student perspective (Appendix 1).

At the end of the 2nd week the AHP Education Lead met with the clinical lead to ascertain how the placement was progressing, and also met with the 2 students to explain her role, the ethos of the placement and an explanation of how it would be evaluated. It was explained that the purpose of the evaluation was about ‘learning’ and in no way was part of an assessment process. The students were also encouraged to contact the AHP Education Lead at any point during the placement if they wished to.

The purpose of the evaluation was to learn about the strengths and weaknesses of the placement in order to build on this in future placements. It was felt that
a semi-formal group discussion would facilitate the best exchange of information and an information sheet was sent to all participants approximately a week prior to the evaluation in order for them to focus their thoughts and also to give them the opportunity to think of any other topics they wished to discuss. The AHP Education Lead met with the student group and the educator group 3 days before the end of the placement for approximately an hour each. The meetings were recorded and notes were taken. At the end of each meeting the AHP Education Lead clarified any points that she was unsure of to ensure accuracy.

The topics discussed included:
- models of supervision;
- thoughts pre-placement and on placement;
- accessibility to learning resources;
- placement as a learning experience;
- SWOT analysis of the placement.

Results
The results of the evaluation will be divided into the following sections:
- models of supervision;
- accessibility to learning resources;
- feedback on placement experience; student & educator.

Models of Supervision
Although students work with classmates whilst in University, e.g. in practical classes and considered that the norm, having another student on placement with them was considered something totally different, and neither student had experienced a placement using a PAL model of supervision. Both reported feeling quite anxious prior to the commencement of the placement and thought that there might be an element of competitiveness. However, they both felt that it had worked well and that they were able to bounce ideas off each other as well as being able to ask each other the ‘silly questions’ they might have hesitated to ask an educator.

Both students felt that it actually lessened the pressure on them to always know the answer. The students were asked to rate the experience of having another student on placement with them from 0-10 (0 being awful and 10 being excellent); both students rated the experience as 7.

It was felt that guidance from the University regarding differing models of supervision and expectations would have been helpful and could have enhanced the experience further. However, it is acknowledged that due to the paucity of areas offering PAL placements this would have been difficult.

The educators reported that the students were far more pro-active at using each other as educators and challenging each others thinking. They did feel that in future placements there was more potential for peer learning than they had utilised but that the balance between individual and peer learning had been good. They also reported that they had utilised peer learning for themselves during the placement and that this had been very useful.

Both groups reported that the pre-planned programme had been instrumental in providing structure and helped both students and educators identify when students were expected to be working individually and when they were working together.

Accessibility to Learning Resources
For students at this HEI a virtual learning environment (VLE) is utilised to facilitate learning and is also utilised for sharing placement resources. The students reported that it would have been beneficial to have had access to information re. the nature of the placement, caseload mix and a directive pre-placement reading via the VLE. However, as this had been a new placement the pre-placement resources had not been available, and instead the lead educator had spoken directly with the students prior to placement commencement and a pre-placement pack is in development. The students also made general comments re. time for preparing for placements and the use of VLE resources however these were generalised comments and are therefore not pertinent to this paper.

Both students felt that the department had a good selection of books but suggested a resource file with journal articles would also be of benefit. However, they did have access to the internet and were able to look for articles there and thus self-directed learning was being facilitated. It was suggested that adapting the staff grade folder to create a student folder would also add to the resources available.

Feedback on placement experience - student
The students were asked to score the placement from 0-10 (0=Very poor and 10=very good) and both again scored the experience as a 7.

Some of the strengths of the placement that the students reported were the mix of caseload and settings, opportunities for inter-professional and
inter-agency learning and practice. One of the biggest strengths they felt were the educators themselves - approachability, clinical experience, different approaches and ideas and the ability to work as a team.

The weaknesses that they reported were around IT accessibility, occasional lack of space in the department and timing of feedback. However, both students commented that they were struggling to identify negative features and that they did not really reflect on the overall placement.

Feedback on placement experience - educator

Although the educators had felt anxious before the placement they all felt that the experience was a positive one and had been good for their learning as well as the students. Indeed the fact that they all had the opportunity to give input into the students’ assessment and that their judgements were corroborated was helpful in validating their assessment process. Meldrum et al (2008) investigated the inter-rater reliability of educators’ assessments and concluded that physiotherapy educators demonstrated a high level of reliability with a standardised assessment. Although it is not possible to make a definitive statement with regard to inter-rater reliability in this instance, each educator did contribute to the final assessments and discussed their contributions and there was agreement throughout. They felt that the PAL model worked well for themselves and the students and that the clinical opportunities available was an also a major strength.

The educators were more critical of themselves and the placement than was warranted and commented upon weaknesses around planning within out-patients and having activities available for students if patients had cancelled an appointment unexpectedly. They did however comment that sometimes they had assumed a level of knowledge from the students which wasn’t there and re-enforced the need for more in-depth discussions at supervision periods.

Discussion

The aim of the placement pilot had been to:

- introduce paediatric physiotherapy as a potential career pathway by taking students on placement;
- use an enthusiastic department to facilitate an innovative paediatric placement;
- use a supportive HEI to pilot this placement option and to allow feedback to be gathered from students and educators to inform future placement provision.

Informal feedback from the students at the end of the placement indicated that they would certainly consider paediatric physiotherapy as a career option. The author does however recognise that at the end of a placement and in the current climate where staff grade posts for newly qualified practitioners are scarce this might not be a true indicator to base any facts upon. The other dimension however is research conducted by Thomas (2007) which indicated that for students seeking employment it was 74% moderately or very beneficial to seek employment with a previous practice placement educator.

The second aim was undoubtedly achieved and contrary to anecdotal evidence and reports in some papers (Thomas 2007) having a mix of educators, all of whom were part-time, was reported as a strength of the experience by students and educators. Student ‘down-time’ when patients had cancelled or failed to attend was an area that could have been managed more effectively. The educators recognised this and they are being pro-active for future placements identifying potential student projects which will enhance the placement experience and give students the opportunity to add something to the department. This approach has been utilised elsewhere and anecdotal evidence from students indicates that they really appreciate this especially when presenting their project at the end of the placement.

Supervising students on placement is also a learning opportunity for the educators and feedback corroborated this. Any successful placement needs preparation beforehand (Lekkas 2007), however having more than one student does not necessarily increase the workload by the number of students (Baldry Currens 2003, CSP 2002, Lekkas 2007). It was undoubtedly helpful having the opportunity to plan the whole placement and discuss with the HEI and the AHP Education Lead first’ however it would be very surprising if an HEI would be unwilling to commit time to help practice placement educators prepare for adopting a new model of supervision.

Conclusion

The PAL placement model fits well into a paediatric physiotherapy department with part-time staff. Although it was not a ‘pure’ PAL model as the entire team were able to contribute to the students experience (CSP 2002), it perhaps reflects how innovative and enthusiastic the educators were. The fact that there are potentially many departments across the UK that have part-time physiotherapists who, because of this, feel unable to take students
should feel enabled to try this approach. Hopefully this would have the dual benefit of increasing the pool of potential paediatric physiotherapists as well as increasing placement opportunities and the pressures for HEI’s of allocation.

Although the HEI concerned in this pilot does introduce the different models of supervision at the start of year 3, the fact that most students don’t actually experience the PAL model does not allow them to put this learning into practice. It might be helpful if students are about to have a PAL placement, that some specific pre-placement material is available to ensure they get the most out of the placement. This could be in the format of case study or reflective notes from other students or indeed from the practice placement educators.

Once educators are familiar with the experience and theories around peer assisted learning it offers significant opportunities on placement. Additionally it supports adult learning and evidence suggests it facilitates more autonomous practitioners on graduation (NES 2007, Lekkas 2007).

Finally, the department have already arranged to repeat the experience which in itself is positive re-enforcement.

References


Chartered Society of Physiotherapy (2002) Guidelines for implementing the Team and Split Placement Models in Physiotherapy Practice Placements. The Chartered Society of Physiotherapy CE 06


Lekkas et al (2007); No model of clinical education for physiotherapy students is superior to another; a systematic review. Australian Journal of Physiotherapy Vol 53, 19-28


Scottish Executive Health Department (2006). Delivering Care, Enabling Health: Harnessing the Nursing, Midwifery and Allied Health Professions’ Contribution to Implementing Delivering for Health in Scotland. SEHD, Edinburgh

Thomas, Y et al (2007) Benefits and challenges of supervising occupational therapy fieldwork students; Supervisors’ perspectives. Australian Occupational Therapy Journal. 54, S2-S12


Appendix 1:
Paediatric Physiotherapy Practice Placement Pilot Evaluation

The information below was sent to the educators and students in advance of the semi-structured discussions to enable both groups to prepare for the session.

This placement has been the first of hopefully many Paediatric Physiotherapy placements. However in order to make sure the educators and the organisation can learn as much as possible from the experience the AHP Education Lead will be evaluating the placement from a student and educator perspective. In order to do this the AHP Education Lead will meet with the students for an hour towards the end of the placement. The students have also been encouraged to share any information they wish to before this time either by phone or e-mail. The AHP Education Lead will also meet with the educators for an hour and they too should feel free to contact AHP Education Lead before meeting if wished.

The discussion time is seen very much as a learning experience to celebrate the successful elements of the placement but also to find out what would enhance it further. It forms NO part of any assessment.
In order to get as much information as possible out of the evaluation detailed below are the areas which have been identified as useful. However the sessions will be informal and other areas can be raised.

**Educators Evaluation Topics**

*Experience to date:*
- students;
- practice placement educator training;
- how supervision was provided;
- experience of placement with another student previously?

*Pre-placement:*
- information/resources/education that would have been beneficial and why as an educator and also to share with students;
- has any training/learning need been identified as an educator.

*On Placement:*
- examples of peer learning;
- examples of individual learning;
- SWOT analysis of placement experience - caseload mix, educator mix, feedback, balance between educators;
- opportunity for inter-professional learning.

**Student Evaluation Topics**

*Experience to date:*
- number and areas of previous placements;
- how supervision was provided;
- experience of placement with another student previously?

*Pre-placement:*
- information/resources/education that would have been beneficial and why.

*On Placement:*
- learning resources - availability, appropriateness of them, what else would have been helpful?
- examples of peer learning;
- examples of individual learning;
- was the balance right?
- SWOT analysis of placement experience - caseload mix, educator mix, feedback.
This large tome, which grows with every edition, provides a comprehensive update on paediatric orthopaedic conditions. Although its target audience is orthopaedic registrars and trainees, it has much to offer paediatric physiotherapists who are involved in the management not only with children and young people with disability who are facing orthopaedic interventions but any child who develops skeletal problems, whether transitory, self-limiting, traumatic or of a chronic nature.

The book is well laid out. Many chapters have been rewritten and new chapters added. The editors have provided some of the chapters but other authors have been enlisted from the USA, Australia, Europe, China, Scandinavia, India, Malaysia and South Africa, as well as the U.K.

The foreword by Eugene Bleck describes the tremendous progress made in diagnosis and treatment of paediatric orthopaedics and fractures, using 'the revolutionary change by Ponseti' as an example of a change in orthopaedic management, where conservative treatment of clubfoot has successfully reduced the extensive surgery previously needed.

The text is divided into sections, with the first beginning with a general overview of the management of children within orthopaedic units and emphasises the importance of a multidisciplinary team to provide optimal care. It is pleasing to find discussion of the role of the physiotherapist and extended scope physiotherapist in the text, as well as that of other health professionals. The following chapter gives an overview of skeletal growth from the foetal stage to skeletal maturity and an explanation of normal skeletal variance, including the useful 5Ss check list as an aide memoire to identify the normal from the pathological. Recognition of the challenges of transition to adult services is acknowledged in a chapter on the management and support of children and young people with disability. This chapter also covers issues raised in the exemplar conditions of neural tube defects, cerebral palsy and Duchenne muscular dystrophy as posture seating and mobility, orthoses, control of tone and positioning and maintenance of ambulation which will gladden the hearts of many physiotherapists.

Part II consists of 9 chapters on generalised disorders from bone, cartilage and fibrous tissue disorders to bone tumours. The chapter on gait analysis is a useful overview and concludes that soon forward simulation techniques will permit the creation of biomechanical models where surgery and its outcomes may be simulated before definitive treatment. Other chapters in this section cover the unusual metabolic and endocrine disorders of the skeleton, blood disorders and AIDS, bone and joint infections and juvenile idiopathic arthritis as well as children's orthopaedics in the tropics and skeletal tuberculosis.

Neuromuscular disorders are discussed in Part III with a very interesting chapter on neuromotor development and examination as well as chapters on hereditary and developmental neuromuscular disorders, neural tube defects, poliomyelitis, cerebral palsy (orthopaedic management) and arthrogryposis. All these chapters are well illustrated and there is useful discussion about the role of orthopaedic surgery in facilitating function.

In Part IV regional disorders are divided into four sections – each section concentrating on a section of the skeleton: the upper limb, the lower limb, the foot and ankle, and lastly the spine. Taking the lower limb as an example 'the limping child' is one that will have been seen by many paediatric physiotherapists and there are helpful tables in this chapter on history taking, assessment and differential diagnosis. The chapters on the spine are particularly useful in helping to deepen understanding of spinal deformities and the discussion of the lack of evidence for effects of conservative treatment of scoliosis, particularly spinal bracing, is valuable.

Just over 200 pages are devoted to the final section, which covers fractures ranging from simple fractures to complex, including those acquired by poly trauma and non-accidentally. The principles of fracture care and epidemiology are covered and highlight how frequency of different fracture types, and the incidence of fractures, are influenced by factors such as age, cultural and environmental factors, and the climate. I had never realised that trampolines were so dangerous!

This is a huge book in all aspects of the word. It is the sort of book that you dip into to look for information about an orthopaedic condition but find yourself drawn to look further through the book! The authors have all provided chapters in a clear and concise fashion, with excellent illustrations - the mark of good editing. It is expensive - so sadly may be beyond the means of most physiotherapy departments. Perhaps your friendly orthopaedic surgeon could be persuaded that it would be a vital resource for his unit or hospital library.
Book Review: Down’s Syndrome – The Essential Guide

Antonia Chitty and Victoria Dawson
Need-2-Know 2010
ISBN – 9 781861 440831

Reviewed by Julie Burslem

This is the latest guide by “Need-2-Know” who have published a number of very informative books for parents and professionals covering a wide range of topics from allergies, to child obesity to special educational needs.

Antonia Chitty is a freelance health writer and author of a number of books on parenting and business and Victoria Dawson is a teacher who has taught in Special Needs schools, has a diploma in counselling and is a trained sleep counsellor.

The book is in paperback format and is 127 pages long. It is divided into 10 chapters covering the definition of Down’s syndrome through to transition to adulthood. It also has a very useful help list at the end detailing support groups and contacts that might be useful to support a child with disability as well as a book list of other useful publications.

The guide is focused mainly towards parents and carers of a child with Down’s syndrome and explains in a very easy to read format exactly what Down’s syndrome is, how to come to terms with the diagnosis and strategies to enable the family/carers to move forward. The book follows the child’s development through the early years, into school settings and towards transition to adulthood covering topical areas such as dealing with health issues and offering advice on how to address the stress and anxiety associated with having a child with a disability and additional issues that can arise such as sleep difficulties. It also discusses the financial implications having a child with a disability can have on the family and how to access the benefits that are available.

As the child moves through the educational and health systems there is an informative section on how to work with professionals and make the numerous meetings they have to attend as productive and as stress-less as possible. The final chapter covers moving towards adulthood and how to enable the full potential of the young adult to be developed.

At the end of each chapter there is a quick action check list offering advice on areas that the reader might want to follow up on and a summary of the chapter’s content. There is also parent feedback throughout the chapters that adds to the informative nature of the book. The help list at the end of the book is divided into 3 sections covering education, financial and family and healthcare; some of the reference as more specific to England and Wales, but all offer valuable information.

This is a well written and easy to read guide that would be very useful for a family who have a newly diagnosed child with Down’s syndrome or have discovered that their unborn child is at high risk of having the condition. It would also be a good reference book to loan out to families and carers or people with limited understanding of the condition.
Bethlem Myopathy

Bethlem Myopathy (BM) was first described in 1976. It is caused by a fault in one of three genes for the protein Collagen VI. Mutations cause abnormal or reduced collagen VI which disrupts the extracellular matrix surrounding muscle cells. Approximately 50% of cases are inherited in an autosomal dominant way, i.e. the child has an affected parent. Mildly affected parents may be unaware they have the disorder. Autosomal recessive cases are rare and others are new mutations. Incidence is reported as 1:200,000 in the USA, but this may be due to under-diagnosis. Diagnosis can be confirmed by blood tests for gene mutation and possible muscle and /or skin biopsy. MRI shows characteristic patterns of muscle involvement. Mutations in the collagen VI genes also give rise to Ullrich Congenital Muscular Dystrophy and the two disorders are considered to be differing severities on the spectrum of a single disorder.

Presentation

Features of Bethlem Myopathy can appear at any age, from prenatal onset to adulthood. Babies with Bethlem Myopathy can present with weakness, hypermobility of the joints, torticollis and possibly delayed milestones. They will develop contractures when older. Other infants and children can present with contractures, tight tendo-achilles (TA), persistent torticollis, long finger flexor tightness and, less frequently, knee contractures.

Children with BM will achieve and maintain ambulation but this can be restricted by severe TA tightness. With progressive weakness, adults can find walking more difficult and may need walking aids, or wheelchairs for outdoor mobility.

Intellect is not affected. Thin skin with excessive or keloid scarring and prolonged healing time can be a feature. Cardiac involvement has not been reported. Occasional weakness of respiratory muscles leads to increased chest infections in some adults.

Physiotherapy

The physiotherapy assessment measures muscle power, joint range of movement/contractures (including the neck), functional difficulties and mobility. Bethlem Myopathy should be considered in undiagnosed toe walkers. A family history of toe walking, elbow tightness, back problems and thick scarring post injury or surgery may be noted. Presence of long finger flexor tightness, elbow contractures or reduced ankle range can be evaluated in the parents.

Management of contractures and maintenance of mobility are the priorities.

Contractures can be managed through:

a) daily stretches of the ankles, elbows and fingers with self stretches for the older child. Hamstring tightness will occur but can be managed through long sitting;

b) orthotics – night resting splints should be introduced with any loss of ankle range;

c) serial casting can be used to regain ankle movement but as muscles are affected, should not last more than two weeks. Children must continue walking in the casts. Casting will lose effectiveness with repeated applications. Night splints will assist in maintaining range gained;

d) surgery – tendon lengthening for the ankles will frequently be needed. Clinical experience suggests post-operative day and night orthoses for three months after which the day splint wear is gradually reduced. Hamstring surgery should be avoided; it is painful, rarely effective
and the results do not last. Hamstring tightness does not interfere with function. Weakness is rarely severe and children are advised to maintain activity with symmetrical sports and games such as swimming, cycling, football, martial arts, etc.

Independent mobility should be maintained with some children needing wheelchairs for longer distances. The use of crutches should be limited in children with upper limb weakness/contractures.

**Conclusion**

Bethlem Myopathy is a disorder of collagen VI which causes slowly progressive muscle weakness and increasing contractures. Physiotherapy for children should be directed at improving or maintaining joint range and overall mobility.

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**References**


SUMMARY OF THE UPDATED COCHRANE REVIEWS
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BOTULINUM TOXIN A AS AN ADJUNCT TO TREATMENT IN THE MANAGEMENT OF THE UPPER LIMB IN CHILDREN WITH SPASTIC CEREBRAL PALSY
Authors: Brian J Hoare, Margaret A Wallen, Christine Imms, Elmer Villanueva, Hyam Barry Rawicki, Leeanne Carey

Botulinum Toxin A (BoNT-A) is used in many paediatric centres as an adjunct to other therapeutic techniques such as splinting/casting, passive stretches, and posture/movement facilitation. This updated review aims to evaluate the evidence for the effectiveness of BoNT-A when used with or without occupational therapy, compared to other types of treatment, no treatment, or placebo, in the treatment of the upper limb in children with cerebral palsy (CP).

The authors of the original review, published in 2004, concluded that on the basis of evidence from the only two randomised controlled trials (RCTs) included, there was not enough evidence at that stage to support or refute the use of BoNT-A in the management of upper limb(s) in children with CP.

For this update, a total of 327 references were identified, narrowed by the authors to 45 potential articles. Of those, 10 RCTs met the criteria for inclusion. The authors discuss the evidence for efficacy in relation to outcomes at the different domains of the ICF (WHO 2001). They conclude that:

- there is a high level of evidence that BoTN-A combined with occupational therapy results in greater improvements in outcomes within the activity levels and body structure and function domains when compared with occupational therapy alone;
- there is moderate evidence that BoTN-A alone, when compared with placebo or no treatment, is not effective.

Therefore, it is recommend that upper limb BoNT-A is accompanied by post-injection therapeutic intervention. However, further evidence is needed with regard to timing, intensity and any specific type of therapy. Finally, clinicians are advised to follow the evidence-based guidelines for intervention and after-care published by Fehlings et al (2010).

Reference:

Main references for studies included in the updated review:


**Other references:**


http://onlinelibrary.wiley.com/o/cochrane/clsysrev/articles/CD003469/frame.html

**CONSTRAINT-INDUCED MOVEMENT THERAPY IN THE TREATMENT OF THE UPPER LIMB IN CHILDREN WITH HEMIPLEGIC CEREBRAL PALSY**

Authors: Brian J Hoare, Jason Wasiak, Christine Imms, Leeanne Carey)

Constraint induced movement therapy (CIMT) aims to increase spontaneous use of the affected upper limb by restraining the unaffected limb, combined with therapeutic activities promoting use of the affected limb. This systematic review, initially published in 2007, and updated in 2009, aims to evaluate the effectiveness of CIMT in the treatment of the affected upper limb in children with hemiplegic cerebral palsy.

The authors place different CIMT treatment methods into three different categories:

- conventional CIMT, where restraint to the unaffected limb is combined with therapeutic activities for more than three hours a day, over at least two weeks;
- modified CIMT (mCIMT), where restraint is combined with therapeutic activities for less than three hours a day;
- forced use, where restraint is used without any additional therapeutic activities.

Of the 214 references identified, 26 potentially relevant articles were found. However, only three met the inclusion criteria for this review; two randomised controlled trials and one controlled clinical trial. The studies compared conventional treatments against one of the three different categories of CIMT.

The review concludes that, although there is insufficient evidence to support any particular one of the three categories of CIMT, the single trial using modified CIMT did demonstrate a significant treatment effect, and the two trials using conventional CIMT and forced use showed a positive trend. However, with such a small number of trials, which had limitations in methodology, support for the established use of this therapy approach would require further high quality research.

**Reference:**


http://onlinelibrary.wiley.com/o/cochrane/clsysrev/articles/CD004149/frame.html
Submissions to the APCP Journal

The APCP Journal aims to disseminate original research, facilitate continuing medical education and to provide an opportunity to debate controversial issues in paediatric physiotherapy. Listed below are the different types of submissions that will be considered for publication in the APCP Journal with guidance on how to write and format your work to maximise the chances of your submission being successful. The Editorial Board also welcome pre-submission questions and will be happy to advise further. Please contact eva.bower@tinyworld.co.uk in the first instance for guidance or pre-submission advice.

Original Research Reports
Original research in many formats, including quantitative and qualitative research, case series and case reports. These articles should be 4500 words or less, excluding the references and abstract. All submissions in this category will be subject to anonymous peer review by 2 reviewers.

Research Papers
Research papers should generally follow the ‘IMRD’ pattern (Introduction, Methods, Results and Discussion). When writing your paper, it is usually best to start with the most important parts, the methods and results, before writing the discussion, introduction and conclusion.

The methods section should include sufficient information to enable other clinicians to reproduce your work. Any work involving human or animal subjects must have appropriate ethical approval from the relevant Research Ethics Committee. In addition, written permission from children, parents or guardians to publish photographs of individuals must be submitted. The methods section should also include details of statistical methods if they are used and state which software, if any, was used to obtain the results. Any apparatus used in the study should be reported in terms of manufacturer and location (city, county, country).

The results section should be clear and easily understood. Rather than presenting the reader with masses of data, it often helps to construct your results to tell a story, taking the reader step by step through your findings. Do not present data twice in both text and tables/figures, and do not include material that belongs in the discussion, i.e. present results only, not interpretation. Consider how statistical data is presented, ensure that descriptive and inferential statistics are used appropriately to provide meaning to the data collected.

Tables and figures should be numbered consecutively as they are referred to in the text, and placed after the references on a new sheet. Abbreviations should be explained in a footnote and only horizontal lines should be used. Table and figure captions/legends should be included on a separate sheet.

The discussion will allow you to succinctly summarise the major findings of your work and explain its relevance in terms of the available literature and current practice. It is helpful if the first paragraph briefly summarises the major findings. The discussion will also allow you to address any potential weaknesses in the methodology and justify why the research was performed in a particular way. It is important to keep the discussion relevant to the results obtained.

Ideally the introduction should be short and engage the reader, explaining why the paper is relevant to clinical practice. Often a brief summary of the existing literature highlighting the need for this particular research is useful, as it leads directly to the research question being asked.

Finally the title and abstract can be written. The abstract should be structured (limited to 300 words) consisting of ‘Background and Purpose’ (why the research done), ‘Method’ (what was done), ‘Results’ (what was found) and ‘Conclusion’ (what was concluded). The title itself should describe the contents of the paper succinctly and accurately.

Scholarly Papers
Discursive papers sharing ideas or experiences in specific areas of practice can be structured more freely but should still include an ‘Introduction’, ‘Discussion’, and ‘Conclusions’. Scholarly papers should be no longer than 4500 words.

Case Studies and Case Series
The format for case studies and case series differs from that given above and should start with an ‘Introduction’, followed by ‘Case Report’ (history, investigations, treatments, outcome), ‘Discussion’ and ‘Conclusion’. Case reports may be notable because they either focus on a rare condition or on a new method of treatment. The use of false names in case reports is encouraged but if a child is recognisable in the report (due to the condition or the specific nature of the treatment given), then written consent for publication should be obtained. Case reports should be no longer than 2500 words.
Audit Reports
Reports of clinical audit should include an ‘Introduction’, ‘Standard Setting’ (with appropriate reference to the available literature), ‘Method’, ‘Results’, ‘Discussion’, and ‘Conclusion’. These should be no longer than 3000 words.

Review Papers
Systematic reviews undertake specific methodology and focus on a specific question, perform a thorough literature search and critical appraisal of individual studies using strict criteria. Less formal review articles will summarise the current literature on a particular topic. The Cochrane Collaboration has published a handbook on conducting systematic reviews (http://www.cochrane-handbook.org/) and you should structure your review in terms of ‘Introduction’, ‘Objectives’, ‘Methods’, ‘Results’, ‘Discussion’, and ‘Conclusion’. There are published criteria that should be applied to the analysis of randomised controlled trials: the Delphi criteria (http://www.ncbi.nlm.nih.gov/pubmed/10086815) and the PEDro scale (http://www.pedro.org.au/scale_item.html). The MOOSE guide- lines should be applied to the analysis of observational studies (http://www.consortstatement.org/mod_product/uplo_ads/MOOSE%20Statement%202000.pdf). Review papers should be no more than 4500 words.

Technical Evaluation
Technical evaluations describe mechanical or technical devices used in clinical practice or education and should include an introduction, methods including the specifications of the equipment used and the means of the evaluation, the evaluation outcome, discussion and conclusions. Technical evaluations should be no longer than 2500 words.

Service Development Report
A service development report should describe changes in service delivery/management. The structure of the report can be less formal but should include an introduction, description of the service change(s), outcome and discussion on the implications for future practice. Service development reports should be no longer than 2500 words.

Abstracts of Theses and Dissertations
Abstracts of research projects, audits and presentations from undergraduate and postgraduate degrees should be no more than 300 words in length and structured as a standard abstract (introduction, methods, results, conclusion). However, the Editorial Board would strongly encourage those considering such a submission to formulate their work instead as one of the above peer reviewed articles. In such cases, a pre-submission enquiry to the editor may be helpful.

Other types of editorial material
The Journal will also consider the following submissions:

Letters to the editor
Letters to the editor can be on any issue pertinent to paediatric physiotherapy or to APCP. Letters should be no more than 500 words long.

Book reviews
Book reviews should be no more than 750 words long.

Referencing
All work submitted for peer review should be referenced in the Harvard style:

In text, cite only the author(s) surname(s) followed by the date of publication, e.g. (Robinson, 1994) or Robinson (1994). ‘a’, ‘b’, etc., is used to indicate more than one publication by the same author(s) in the same year, e.g. 1992a,b). For three or more authors of a cited paper, name the first followed by et al, e.g. (Smith et al, 1990).

In the reference list, include articles in journals and books alphabetically by author. For citations from journals, give the names and initials of all authors (year of publication), title of the article, full name of the journal, volume number, issue number and first and last page numbers, e.g. Brown A, Green B and Gold C (2001). The value of exercise, Physiotherapy, 87, 1, 77-79. Referring to books, give the names and initials of all authors/editors (year of publication), title, publisher, place of publication, and the chapternumber or the page number of the citation or both, e.g. Gardner, M (2001). The Annotated Alice, Penguin Books, Harmondsworth, Chap 10, page 210.
The submission process
Email your submission in the first place in Word format to va@apcp.org.uk, clearly indicating the nature of the submission e.g. case series, research project.

Ensure that your copy includes information about the author (full name, qualifications, email address).

Once your submission has been received you will receive feedback from the reviewers indicating whether the copy has been accepted for publication.

There are a number of levels of acceptance:
• acceptance: no amendments required;
• acceptance: minor amendments required;
• acceptance major amendments required;
• rejection: not suitable for publication in the APCP Journal.

Abstracts should be submitted by 1st July 2011 in electronic format to the APCP Administrator - va@apcp.org.uk.

The abstracts will be selected by peer review according to the ‘Guidance for Submitting Abstracts’ that is available from the APCP website or from the APCP Administrator.

Four abstracts may be chosen for oral presentation. Other selected accepted abstracts will be presented in poster format.

The selected abstracts may be published in APCP’s Conference Proceedings.
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