**Pilot Study To Evaluate The Functional Effects Of A Block Of Bobath Therapy In Children With Cerebral Palsy, Knox V & A Lloyd-Evans (2002)**
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## *Abstract*

This study aimed to evaluate the functional effects of Bobath therapy in children with cerebral palsy. Fifteen subjects, aged 2-12 years, all having a diagnosis of cerebral palsy, were recruited. Children having orthopaedic intervention planned were excluded. A repeated measures design was used with subjects tested with the Gross Motor Function Measure (GMFM) and Pediatric Evaluation of Disability Inventory (PEDI) at six weekly intervals (baseline, before and after Bobath therapy, and follow-up). As the data was of ordinal type, non parametric statistics were used, i.e. Wilcoxon Test. Subjects showed a significant improvement in scores in the following areas following Bobath treatment compared to the periods before and after the Bobath therapy: GMFM total score (P=0.009); GMFM Goal Total (p=0.001); PEDI self care skills (P=0.036); and PEDI caregiver assistance (P=0.012). This demonstrates that in this population, following a block of Bobath therapy, gains were made in motor function and self care.


## *Introduction*

At present it is difficult to demonstrate the effects of physiotherapy on children with cerebral palsy. This is because of the diversity in all aspects: the different motor disorders, the different treatment approaches which lack clear description and the lack of suitable validated evaluative tools. Hur (1995) reviewed 37 studies of therapeutic interventions for children with cerebral palsy, and reported that the majority of the studies had small samples, were poorly controlled and some had a lack of rigour in both experimental design and analysis. Of the seven groups using a comparative design, only two showed a significant treatment effect.

Research to date supports that specific factors associated with physiotherapy have been shown to have a positive impact on the outcome of treatment. The use of specific measurable goals in treatment rather than general aims may be associated with increased motor skill acquisition (Bower et al, 1992; 1996). Providing weekly rather than monthly therapy (Mayo, 1991) and daily rather than weekly/fortnightly therapy (Bower et al, 1996) may accelerate the acquisition of motor skills. This is not supported by other work by Bower et al (2001) where the use of goals did not appear to affect outcome and more intensive daily treatment only produced a limited and temporary improvement. Stretching tight muscle, regular change of position, provision of appropriate equipment and encouraging mobility have all been shown to prevent or slow the deterioration of secondary deformities (Chadd et al, 1999; Myhr & von Wendt, 1991; Tardieu et al, 1988; Watt et al, 1986). Treatment strategies involving both parents and children have been shown to be most effective in achieving enhanced developmental outcome (Short et al, 1989; Shoncoff & Hauser-Cram, 1987; Barrera et al, 1986).

One therapy approach, most widely used within the UK for children with

cerebral palsy is the Bobath approach (Bobath & Bobath, 1984). The Bobath concept emphasises observation and analysis of the client's current functional skill performance and the identification of clear therapy goals. The aim of treatment is to influence muscle tone and improve postural alignment by specific handling techniques, and then to work for better active participation and practise of specific relevant functional skills. It is considered to be appropriate for treating any motor control disorder within the cerebral palsy spectrum. (Mayston,1992; Mayston et al, 1997). Treatment programmes within the Bobath concept are goal focussed. It is forward looking, focusing on the likely potential for secondary deformities and how these may be prevented. Parent/carer education is one of the main elements of the intervention: to facilitate the parent child relationship, to enable the parent to handle/assist with their child's difficulties appropriately, and give an intensive period for practise of activities (Mayston, 1992; Bly, 1991).

There has been a lack of rigorous research into the clinical effectiveness of Bobath (neurodevelopmental - NDT) therapy (Royeen & DeGangi, 1992). Ottenbacher et al (1986) conducted a meta analysis of studies which had investigated the effects of NDT in paediatric populations. This showed that clients receiving NDT or a combination of NDT and other intervention performed better than 62% of subjects receiving other treatment modalities, although the effect size was perceived to be small. Some other small studies have also shown NDT may be of benefit (Jonsdottir et al, 1997; Kluzik, 1990; De Gangi, 1994; Laskas, 1985). However, Royeen and DeGangi (1992) reviewed 19 studies investigating the effects of NDT, finding many to have inconclusive results. There were similar problems with sample size, lack of suitable validated measures and experimental design, as for research into all therapy for children with cerebral palsy.More studies investigating the efficacy of specific interventions are needed which use appropriate experimental designs (Hur, 1995; Royeen & De Gangi, 1992). The purpose of the present study was to investigate the effects of a six week block of Bobath therapy on the function of children with cerebral palsy, this being current practice in Centres run according to the Bobath concept.

The dependent variable was change in function as measured by standardised tests (Gross Motor Function Measure and Pediatric Evaluation of Disability Inventory). The independent variable was the Bobath therapy block. The hypothesis was that the test scores would demonstrate differences pre and post the Bobath therapy block.

## Method

### Experimental Design

A repeated measures design was used with assessment carried out at six weekly intervals: at baseline, prior to Bobath treatment, after Bobath treatment and at follow up. In this pilot study, the children acted as their own controls. The amount of local therapy received by subjects was not altered, but was recorded by the parents.

### Participants

Twenty subjects (aged 2 - 12 years, boys n=12; girls n=8) who were referred

to a UK Bobath Centre (London, Cardiff & Glasgow) for a 6 week block of therapy, were recruited onto the trial, irrespective of the type or distribution of cerebral palsy. Exclusion criteria were receipt of medical procedures likely to affect motor function such as botulinum toxin injections or orthopaedic surgery; and a Gross Motor Function Classification of Level 5 (Palisano et al, 1997). Ethical approval was given by the Ethical Practices Subcommittee at the Royal Free Hospital, Hampstead.

Materials

Two standardised validated measures of function were used:
(A) The Gross Motor Function Measure (GMFM) which assesses gross motor abilities of children with cerebral palsy, in five dimensions: (1) lie and roll, (2) sit, (3) crawl and kneel, (4) stand, and (5) walk, run and jump (Russell et al. 1989, 1993). In children with cerebral palsy, the GMFM has been shown to be sensitive to change during periods of therapy (Bower et al. 1992, 1994a, 1996; Steinbok et al, 1997).
(B) The Paediatric Evaluation of Disability Inventory (PEDI) which assesses mobility, selfcare and social function across three scales: functional skill level, physical assistance typically required of the care giver and any modifications or equipment used (Haley et al.1992). The Inventory is completed on parent interview. The PEDI has been shown to be sensitive to differences between children with differing distributions of cerebral palsy and to change following surgery and therapy (Bloom & Nazar, 1994; Dudgeon et al.1994).

Procedure

Informed written consent was obtained from the parents. Subjects received their baseline assessment (GMFM & PEDI) and parents were asked to record local therapy over the course of the trial. Another assessment took place at six weeks and a parent questionnaire was administered asking if any changes were perceived to have taken place in the child's mobility, activities of daily living, play or communication. Prior to Bobath intervention, three short term treatment goals were agreed with the family and recorded. Intervention began and attendance for treatment sessions was recorded (expected attendance being 16 sessions). At 12 weeks, (the end of the intervention period), the third assessment took place and questionnaires were administered to the parents and treating therapist regarding perceived changes in function. A final assessment took place at 18 weeks.

Data Analysis

In addition to individual dimension scores for the GMFM, the following scores were analysed: GMFM total, GMFM goal total[1], GMFM non-goal total[2] and GMFM-66 scores. The GMFM-66 is a new method of scoring using only 66 test items that have been arranged in order of item difficulty (Russell et al, 2000). This allows an interval score to be calculated representative of the overall level of motor ability of the child, unlike the other GMFM scores, which represent how many and to what extent items are achieved. In addition to individual PEDI domain scores, total scores for functional skills and caregiver

[1] Goal total: determined by observing in which dimension(s) the treating Bobath therapist had set goals at onset of therapy and assigning those dimension(s) as the Goal Total score (if more than one dimension is highlighted, an average score is calculated).
[2] Non-Goal total: an average score calculated from all dimensions not assigned as goal areas.

assistance were calculated[3].
As the data were ordinal and would not follow a normal distribution, non parametric
statistics were used: Wilcoxon's test to see if there was a significant difference between any pair of test scores collected at different times: 0 & 6 weeks; 6 & 12 weeks; 12 & 18 weeks; 0 & 18 weeks. The probability value for statistical significance was set at 5%.

## Results

Of the twenty subjects recruited, five could not be followed up due to: illness during trial (n=2); botulinum toxin injections during trial (n=1); failure to attend majority of treatment sessions (n=1); and communication difficulties causing the subject distress during measurement procedures (n=1). Of the 15 remaining subjects (boys n=9; girls n=6), ages ranged from 2 years 8 months to 12 years. Types of cerebral palsy were as follows:

Table 1: Type of Motor Disorder

| Type of Motor Disorder | Number of Subjects |
|---|---|
| Spastic hemiplegia | 0 |
| Spastic diplegia | 4 |
| Spastic quadriplegia | 9 |
| Choreoathetosis | 1 |
| Dystonic athetosis | 0 |
| Ataxia | 1 |

No children had hemiplegia, which is representative of the population of children referred to Bobath Centres, most children having more complex disabilities. Ten subjects had a variety of associated problems: vision (n=5); hearing (n=2); communication (n=6); cognition (n=2) and significant contractures (n=4). The Gross Motor Classification of subjects was as follows:

Table 2: Gross Motor Classification Levels

| Gross Motor Function Classification Level | Number of Subjects |
|---|---|
| I | 1 |
| II | 4 |
| III | 5 |
| IV | 4 |
| V | 1 |

One subject first thought to be level IV was on more detailed appraisal reclassified as level V. Although the intent had been to exclude Level V children, as the subject had begun the trial, data continued to be collected.

[3] Calculation of total scores are not suggested in the manual, but as this test was thought to be less sensitive over a period of a few weeks, it was thought this might maximise the chance of seeing any change in scores that occurred.

Treatment attendance was good for the majority of the subjects: five attended for all 16 sessions; nine attended for between 11 and 15 sessions, and one subject only attended for six sessions. Eight parents completed the local therapy forms. Local therapy varied in frequency from none to twice weekly. During the Bobath intervention, three reported that local therapy remained consistent, one reported slightly less and four less regular or no local therapy. Fifty-seven GMFMs and 53 PEDIs were completed (out of a possible 60 each). Complete data was available for nine subjects and partial sets for the remaining six subjects, but this was sufficient for statistical analysis. Missing data was largely from the final test at 18 weeks, six weeks after Bobath therapy had finished, where some subjects failed to return for final testing or parental time was limited for completion of the PEDI.

A large proportion of the goals set by the therapist were within areas covered by the GMFM or PEDI, such as relating to sitting, self care, etc. Other goals did not fall within the remit of either measure, for example ' Fill in a missing part on pre-drawn picture'; 'produce breath for group of 3/4 syllables', etc, so neither standardised test could be expected to demonstrate whether these were achieved.

*Gross Motor Function Measure Results*

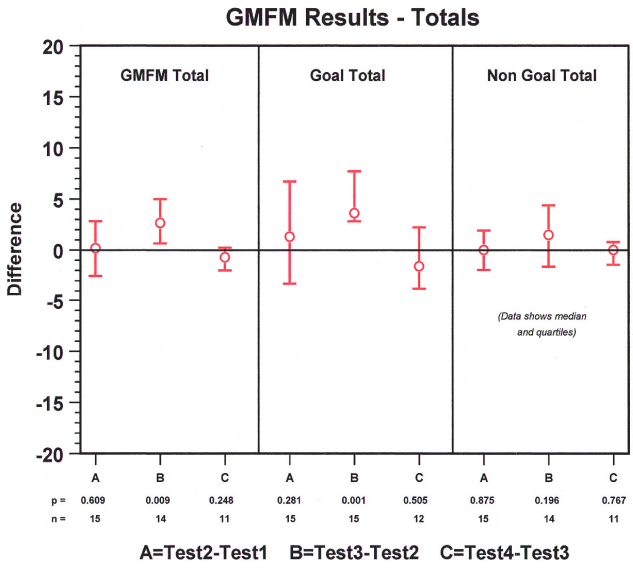
Significant improvements in score following Bobath therapy were seen in the GMFM total scores (p=0.009) and Goal Total scores (p=0.001). There was no significant improvement in the Non-Goal Total scores (p=0.196). GMFM-66 scores showed a significant improvement following intervention (p=0.03), suggesting that children not only achieved higher scores on more items, but were also achieving more difficult items. Significant improvements following Bobath therapy were also seen within the following individual dimensions: walking (p=0.010); crawling (p=0.05) and reached near significant levels in the lying (p=0.66). *See Table3*.

**Table 3: Gross Motor Function Measure – Wilcoxon Signed Rank Tests**

| **Dimension & Total Scores** | **Wilcoxon Signed Rank Tests** | | |
|---|---|---|---|
| | Test 2-1<br>*Baseline* | **Test 3-2**<br>*Bobath intervention* | Test 4-3<br>*Follow-up* |
| **Lying** | 0.645 (z=-0.460 ) | 0.066 (z=-1.963 ) | 0.670 (z=-0.426 ) |
| **Sitting** | 0.262 (z=-1.121 ) | 0.259 (z=-1.128) | 0.670 (z=-0.426) |
| **Crawling** | 0.068 (z=-1.823) | **0.050** (z=-1.958 ) | 0.786 (z=-0.271 ) |
| **Standing** | 0.075 (z=-1.782 ) | 0.507 (z=-0.664) | 0.440 (z=-0.772) |
| **Walking** | 0.720 (z=-0.358) | **0.010** (z=-2.580) | 0.735 (z=-0.338) |
| **GMFM Total** | 0.609 (z=-0.609) | **0.009** (z=-2.605 ) | 0.248 (z=-1.156 ) |
| **Goal Total** | 0.281 (z=-1.079) | **0.001** (z=-3.408) | 0.505 (z=-0.667) |
| **Non Goal Total** | 0.875 (z=-0.875 ) | 0.196 (z=-1.293) | 0.767 (z=-0.296) |
| **GMFM - 66** | 0.65 (z=-0.454) | **0.030** (z=-2.166) | 0.515 (z=-0.652) |

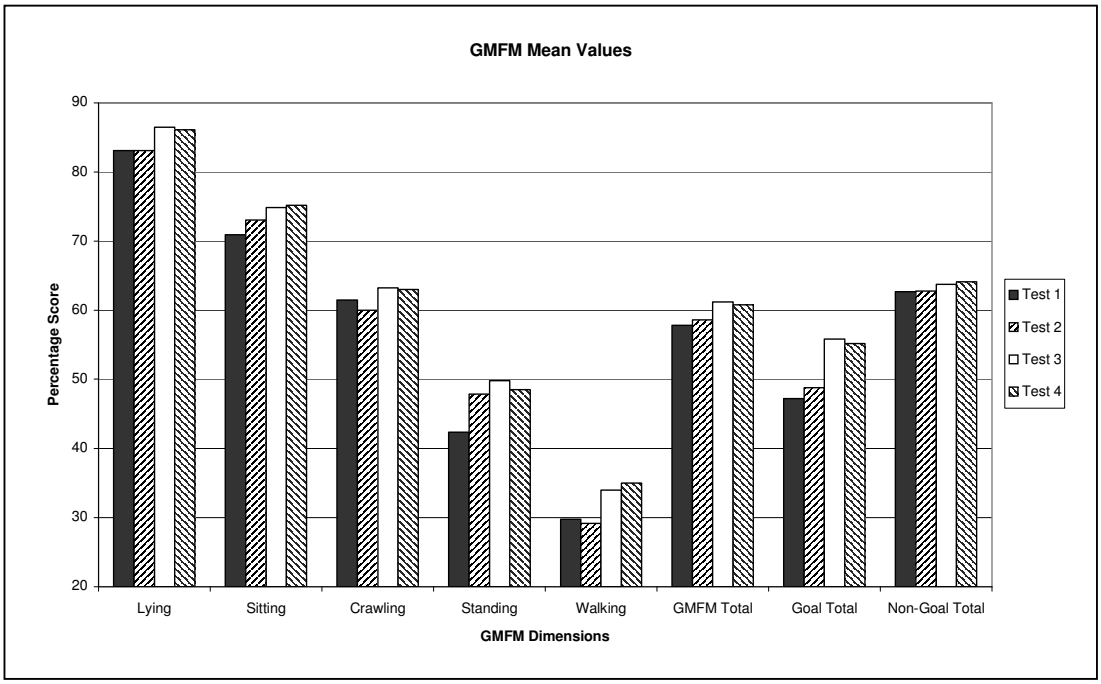
This is also illustrated in *Figure 1*, which presents inter-test differences for the total scores, expressed as median differences and 25th and 75th percentiles of the distribution.

Figure 1: Median and Quartiles of Inter-Test Difference Scores for GMFM, Goal and Non-Goal Totals




No significant treatment effects were seen in the scores for Sitting (p=0.259) or Standing (p=0.507) dimensions. The subjects did show an overall improvement in score in these areas from the beginning of the study to the end, but this appeared unrelated to the Bobath therapy. This can be seen in the graph displaying mean values for GMFM scores *(see Figure 2).*

Figure 2: Gross Motor Function Measure - mean values



achieved a score of up to 88% (*see Table 4)*. The standard deviations are therefore not very advantageous in helping to interpret the data.

Table 4: GMFM Walking Dimension – Descriptive Statistics

| Test | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| 1 | 29.75 | 31.91 | 0 | 87.5 |
| 2 | 29.17 | 29.75 | 0 | 79.2 |
| | | Bobath | Therapy | |
| 3 | 33.97 | 34.05 | 0 | 88.9 |
| 4 | 34.96 | 34.10 | 0 | 87.5 |

*Pediatric Evaluation of Disability Inventory Results*
Significant improvements occurred in scores following Bobath therapy in the following domains: Self Care functional skills (p=0.031); Self care caregiver assistance (p=0.036); Mobility caregiver assistance (p=0.015) and Total Caregiver Assistance (p= 0.012). In other domains, mean scores improved over the whole course of the trial, but did not show a significant improvement post Bobath therapy *(see Figure 3).* The clearest difference between the results of the different trial periods was apparent for self care functional skills and the total caregiver assistance: both the baseline and follow-up period showing no significant improvements, whereas after Bobath therapy, there was a significant improvement. *(See Table 5).*

Table 5: Pediatric Evaluation of Disability Inventory: Wilcoxon Signed Rank Tests

| **Domain & Total Scores** | | **Wilcoxon Signed Rank Tests** | | |
|---|---|---|---|---|
| | | Test 2 - 1 *Baseline* | **Test 3 - 2** *Bobath intervention* | Test 4 - 3 *Follow-up* |
| **Functional skills** | Self Care | 0.359 (z=- 0.918) | **0.031** (z=- 2.158) | 0.753 (z=- 0.314) |
| | Mobility | 0.17 (z=-2.397 ) | 0.678 (z=- 0.415) | 0.080 (z=- 1.753) |
| | Social Function | 0.388 (z=-0.863 ) | 0.141 (z=-1.471) | 0.498 (z=-0.677) |
| | Total | 0.116 (z=-1.572) | 0.064 (z=-1.852) | 0.086 (z=-1.718) |
| **Caregiver Assistance** | Self Care | 0.814 (z=-0.235) | **0.036** (z=-2.100) | **0.043** (z=-2.028) |
| | Mobility | **0.021** (z=-2.312) | **0.015** (z=-2.429) | 1.000 (z=-0.000) |
| | Social Function | 0.449 (z=-0.756) | 0.326 (z=-0.981) | 1.000 (z=-0.000) |
| | Total | 0.101 (z=-1.642) | **0.012** (z=-2.510) | 0.110 (z=-1.599) |

Figure 3: Mean Values for PEDI Domain Test Scores

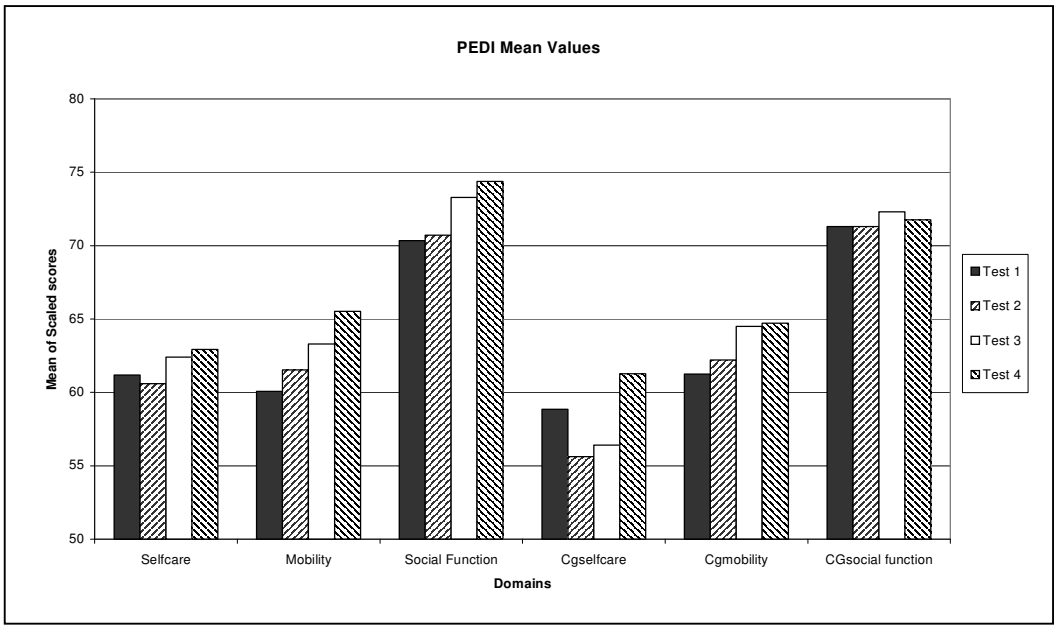
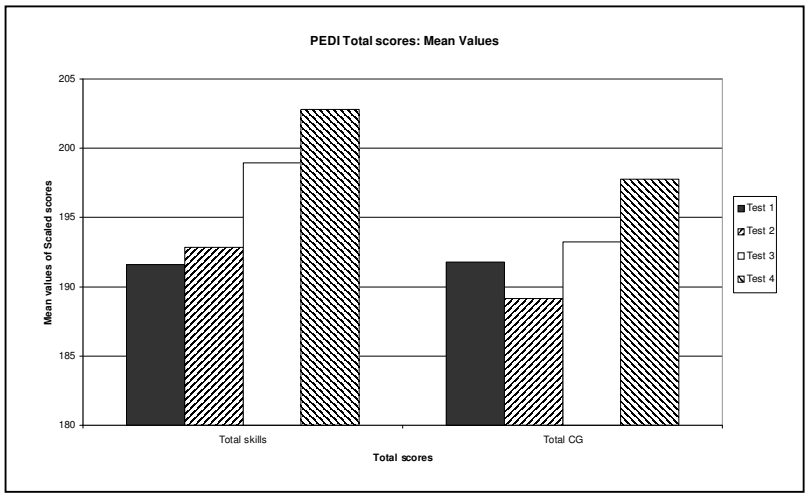



Figure 4: PEDI Mean Values for Total Scores




Improvements appeared to occur within domains of the PEDI within which goals had been set. Eight children had goals set within the remit of self care functional skills, with the majority being in the area of dressing skills. Improvements occurred in the following areas: dressing (n=7); washing/drying (n=4); tooth brushing (n=2); and nose care (n=1). Six subjects had goals set within the remit of self care caregiver assistance with five being in the area of dressing and one for eating/drinking. Improvements occurred in the following areas: dressing (n=5); eating/drinking (n=3); grooming (n=1); bathing (n=3). Seven subjects had goals set within the remit of mobility caregiver assistance, relating to transfers, indoor and outdoor locomotion and stairs. Improvements occurred in the following areas: transfers (n=7, of which 5 were bath transfers); stairs (n=1); and outdoor locomotion (n=1).

Of the nine parents who completed questionnaires, eight reported more positive changes occurring in the six weeks after the Bobath therapy than in the six weeks preceding it. The exception was the parent of a subject who only attended for six treatment sessions, where there was little difference. There was a large degree of overlap between the changes reported by the therapists and those of the parents.

## Discussion

In this small pilot study, subjects showed a significant improvement over the six week intervention period, compared to the pre and post treatment scores, in the following areas of gross motor function: walking ($p=0.010$); crawling ($p=0.05$); GMFM total ($p=0.009$) and Goal Total scores ($p=0.001$). The score for lying nearly reached significance ($p=0.66$).

The most significant result was seen in the goal totals ($p=0.001$). No significant change was seen in the non-goal total score ($p=0.196$), which suggests that change was achieved in the goal areas where therapy was concentrated. This provides some support for the study by Bower et al (1996) where the use of goals enhanced treatment outcome over a treatment period of 2 weeks. It differs from the pilot study by Bower et al (1992) where the differences in scores between the goal and non goal totals was less apparent. However in both this present study and that of Bower (1992), small subject populations were used and inevitably there will be considerable diversity in their population characteristics. Also, there was a difference in the time periods of treatment (two versus six weeks). It differs from the randomised controlled trial with a six month intervention period by Bower et al (2001), where minimal benefit was observed from the use of goals and more intensive daily treatment.

Change was not detected in the sitting dimension, although this area was mentioned as one of the goal areas for nine subjects. Positive changes were reported after therapy by all therapists and all but two parents. Several reasons could account for no changes being recorded on standardised testing.

First it is certainly possible that no overall change took place in this area within this population of subjects, despite the reports of therapists and parents to the contrary. They may have had bias due to having expectations, after setting goals. Secondly, sitting was the dimension where the largest number of subjects started with a score of >95 leaving a smaller degree of freedom for change ($n=8$ at baseline), demonstrating the 'ceiling effect' of the GMFM. Thirdly, some subjects were reported to have an improvement in a skill or quality of sitting not tested by the GMFM, such as reaching while bench sitting. In conclusion, there may have been a Type II error, that is a change occurred in sitting function, which was not detected by the standardised measures used in this study.

Change was not detected in the standing dimension, with seven subjects having this as a goal area. There was little difference between the test results

of those that had standing as a goal area and those subjects that did not. However, two thirds of therapists and parents reported improvements in standing, after Bobath therapy. Attributes of standing described as being improved included balance, stability, standing for longer, more extended in standing and standing straighter. Some aspects of balance are tested within the GMFM, but posture in standing and length of time standing beyond 20 seconds are not measured, so any improvements within these areas would not be detected by this test.

Significant improvements occurred in PEDI scores following Bobath therapy in Self Care functional skills ($p=0.031$); Self care caregiver assistance ($p=0.036$); Mobility caregiver assistance ($p=0.015$) and Total Caregiver Assistance ($p= 0.012$). While skill level only showed improvement in one domain, less caregiver assistance was required overall.

It is interesting that the level of assistance required for bath transfers decreased, when this was not set as a goal on any occasion. However, this skill includes elements of sitting balance, weight transference in sitting and/or standing; standing balance; the ability to lift one leg; etc. These skills were being addressed within other goals.

Improvement was not seen overall in the mobility skill section of the PEDI. Ten subjects had goals set within this domain. Although the skill level of subjects as measured on the PEDI did not change during the treatment phase, the level of caregiver assistance required for such tasks decreased.

Improvements were not seen in social function. Only a small proportion of this group of children were either seen by a speech and language therapist during their therapy or had goals set in this area ($n=3$). The Social Function domain provides only a limited assessment of communication skills with quite large steps between each item/level and was not sufficiently sensitive to detect changes likely to occur over a six week period.

Although the two standardised measures chosen are among the best available for children with cerebral palsy (Ketelaar, 1998), they do have limitations. It was apparent from the parent and therapist questionnaires that other changes were perceived to occur, both in improved functional skills and quality of movement. The GMFM and PEDI only measure certain aspects of function and do not purport to measure how a child performs a task such as speed, co-ordination and fluency of movement (Wright et al, 1998).

To obtain a maximum score on the GMFM, the child must attempt as many items as possible. However, if a child can achieve an item at a higher level, such as crawling, they may be reluctant to attempt an item at a lower level, such as creeping in prone. Children can therefore possibly function at a higher level, but achieve a lower or similar score due to refusal or poor attempts at lower level items. Subject 18 was very reluctant to attempt the easier items particularly those on the floor, as he could function very well when up against gravity in standing/walking.

Floor and ceiling effects can affect the sensitivity of a test. If a child is already performing at near 100% or baseline, there are limited degrees of freedom for change (Russell et al, 2000; Stanley et al, 2000). McClaughlin et al (1998) suggested that there might be a difference in level of difficulty of items in different parts of the range of the GMFM scores with the upper range being less sensitive to change. The scale is ordinal and differences between scores are not intended to represent equal differences of ability.

The GMFM- 66 has since been devised in an attempt to overcome some of these difficulties (Russell et al, 2000), allowing a score to be calculated which represents the level of difficulty of item that the child has reached, on an interval scale. Disadvantages include that this scale appears less sensitive than the GMFM in detecting change in children over five years of age and many items have been removed from the lying and sitting dimensions making it potentially less sensitive to change for the more severely involved child. In this study, subjects showed a significant improvement in GMFM-66 scores post Bobath intervention ($p=0.03$) compared to baseline and follow-up periods, however this was not as significant as their GMFM total ($p=0.001$) and goal total scores ($p=0.009$).

The PEDI is based on a parent questionnaire rather than direct observation, which can introduce bias in either direction (Knox & Usen, 2000). Sensitivity studies carried out using the PEDI have all been over periods of at least a few months. One of the authors has suggested that within the CP population, this test is more likely to be sensitive over months rather than weeks (Coster, 1999 *personal communication*). However, change was apparent in this study over a period of six weeks, despite these possible limitations.

No control group was studied, the children acting as their own controls in this study; this together with the small sample size does limit the power of the results. For the planned main trial, subjects will be stratified into age bands and GMFCS levels, and randomised into one of two groups: a treatment group as described in this study; and a control group which will be measured at the same time intervals with no Bobath therapy being instigated.

**Conclusion**

Within this population sample, subjects improved significantly in gross motor and self-care skills and required a lower level of caregiver assistance for mobility and
self care, as measured on the GMFM and PEDI, following a 6 week block of Bobath therapy. Most improvements occurred within areas in which therapy goals were set. If this can be confirmed by a larger randomised controlled trial, then it may provide useful information to empower parents, therapists and purchasers in decision making regarding appropriate therapy.

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